Appendix A. Search Strategies

Resources Searched

ECRI Institute information specialists searched the following databases for relevant information. Search terms and strategies for each resource appear below.

Name	Date Limits	Platform/Provider
The Cochrane Central Register of Controlled Trials (CENTRAL)	Inception [1999] through November 3, 2016 (KQ1) Inception through June 22, 2016 (KQ2)	Wiley
The Cochrane Database of Systematic Reviews (Cochrane Reviews)	Inception [1999] through November 3, 2016 (KQ1) Inception through June 24, 2016 (KQ2)	Wiley
Cumulative Index of Nursing and Allied Health Literature (CINAHL)	Inception [1981] through November 4, 2016 (KQ1) Inception through June 23, 2016 (KQ2)	EBSCOhost
Database of Abstracts of Reviews of Effects (DARE) (part of the Cochrane Library)	Inception [1999] through November 3, 2016 (KQ1) Inception through June 24, 2016 (KQ2)	Wiley
EMBASE (Excerpta Medica)	Inception [1966] through November 3, 2016 (KQ1) Inception through June 22, 2016 (KQ2)	Embase.com
Health Technology Assessment Database (HTA) (part of the Cochrane Library)	Inception [1999] through November 3, 2016 (KQ1) Inception through June 24, 2016 (KQ2)	Wiley
MEDLINE	Inception [1966] through November 1, 2016 (KQ1) Inception through June 22, 2016 (KQ2)	Embase.com
PUBMED (In Process citations)	Inception [1966] through November 3, 2016 (KQ1) Inception through June 23, 2016 (KQ2)	NLM
U.K. National Health Service Economic Evaluation Database (NHS EED) (part of the Cochrane Library)	Inception [1999] through November 3, 2016 (KQ1) Inception through June 24, 2016 (KQ2)	Wiley
Associations and Societies		
American Academy of Allergy, Asthma, and Immunology	June 29, 2016	https://www.aaaai.org/
Asthma and Allergy Foundation of America	June 30, 2016	http://www.aafa.org/
American Academy of Pediatrics	June 30, 2016	https://www.aap.org
American College of Allergy, Asthma, and Immunology	June 29, 2016	http://acaai.org/
Agency for Healthcare Research and Quality Technology Assessment Program	June 29, 2016	http://www.ahrq.gov/research/findings/ta/index.html
American Lung Association	June 29, 2016	http://www.lung.org/
American Public Health Association	June 29, 2016	https://www.apha.org/
American Thoracic Society	June 29, 2016	https://www.thoracic.org/
Centers for Disease Control and Prevention	June 28, 2016	https://www.cdc.gov/
Children's Health Protection Advisory Committee	June 30, 2016	https://www.epa.gov/children/childrens-health-protection-advisory-committee-chpac
Global Initiative for Asthma	June 30, 2016	http://ginasthma.org/
National Center for Healthy Housing	June 30, 2016	http://www.nchh.org/
National Academy of Medicine	June 28, 2016	https://nam.edu/

Name	Date Limits	Platform/Provider
National Environmental Education Foundation	June 30, 2016	https://www.neefusa.org/
National Heart, Lung, and Blood Institute	June 30, 2016	https://www.nhlbi.nih.gov/
United States Environmental Protection Agency	June 28, 2016	https://www3.epa.gov/
United States National Institute of Environmental Health Sciences	June 29, 2016	http://www.niehs.nih.gov/
Other Gray Literature Resources		
ClinicalTrials.gov	Searched August 1, 2016 (KQ1) Searched June 21, 2016 (KQ2)	NIH
Centers for Medicare and Medicaid (CMS) - Medicare Coverage Database	Searched August 2, 2016 (KQ1) Searched July 14, 2016 (KQ2)	CMS
ECRI Institute Library Catalog	Searched August 2, 2016 (KQ1) Searched June 24, 2016 (KQ2)	ECRI Institute
ECRI Institute Members Website	Searched August 2, 2016 (KQ1) Searched June 24, 2016 (KQ2)	ECRI Institute
Health Devices-	Searched August 2, 2016 (KQ1) Searched June 24, 2016 (KQ2)	ECRI Institute
Healthcare Standards	Searched August 1, 2016 (KQ1) Searched June 24, 2016 (KQ2)	ECRI Institute
Internet	Searched August 3, 2016 (KQ1) Searched June 27, 2016 (KQ2)	Google; Bing
Manufacturers	Searched June 24, 2016 (KQ2)	Boston Scientific
Medscape	Searched June 22, 2016	WebMD
National Guideline Clearinghouse™	Searched August 1, 2016 (KQ1) Searched June 24, 2016 (KQ2)	AHRQ
National Institute for Health and Care Excellence, U.K.	Searched August 1, 2016 (KQ1) Searched June 24, 2016 (KQ2)	NHS
TRIP (Turning Research Into Practice) Database	Searched August 4, 2016 (KQ1) Searched June 27, 2016 (KQ2)	Trip Database, Ltd.
U.S. Food and Drug Administration (FDA), including Medical Device databases	Searched August 1, 2016 (KQ1) Searched June 21, 2016 (KQ2)	FDA

Reimbursement

The following Web sites were searched for reimbursement policies: Aetna, Anthem BCBS, BCBS Florida, BCBS of Illinois, BCBS of Texas, BCBS of California, CIGNA, Humana, United Healthcare, Regence.

Hand Searches of Journal and Gray Literature

Journals and supplements maintained in ECRI Institute's collections were routinely reviewed. Nonjournal publications from professional organizations, private agencies, and government agencies were also screened. Other mechanisms used to retrieve additional relevant information included review of bibliographies/reference lists from peer-reviewed and gray literature. (Gray literature consists of reports, studies, articles, and monographs produced by federal and local government agencies, private organizations, educational facilities, consulting firms, and corporations. These documents do not appear in the peer-reviewed journal literature.)

Topic-specific Search Terms

The search strategies employed combinations of free-text keywords as well as controlled vocabulary terms including (but not limited to) the following concepts. Strategies for each bibliographic database follow this table.

Topic-specific Search Terms

Concept	Controlled Vocabulary	Keywords
Asthma	**EMBASE (EMTREE)** asthma/exp 'allergic asthma'/exp 'asthmatic state'/exp 'extrinsic asthma'/exp 'intrinsic asthma'/exp 'mild intermittent asthma'/exp 'mild persistent asthma'/exp 'nocturnal asthma'/exp 'occupational asthma'/exp 'severe persistent asthma'/exp **MEDLINE/PubMed(MeSH)** Asthma[mh] **CINAHL** (MH "Asthma+") (MH "Asthma, Occupational")	Asthma*
General Allergy terms	**EMBASE (EMTREE)** allergen/exp 'disease exacerbation'/exp 'environmental exposure'/exp 'health hazard'/exp **MEDLINE/PubMed (MeSH)** Allergens[mh] "environmental exposure"[mh] **CINAHL** (MH "Allergens+") (MH "Disease Exacerbation") (MH "Environmental Exposure+")	Allergen exacerbation exacerbate irritant sensitive sensitivity trigger

Concept	Controlled Vocabulary	Keywords
Environmental and Household Allergens	**EMBASE (EMTREE)** 'airborne particle'/exp cat/exp cockroach/exp dander/exp dog/exp dust/exp household/exp mite/exp mould/exp 'pest insect'/exp 'pest organism'/exp 'pest rodent'/exp 'pet animal'/exp **MEDLINE/PubMed (MeSH)** "antigens, dermatophagoides"[mh] cats[mh] cockroaches[mh] dander[mh] “dermatophagoides farina”[mh] "dermatophagoides pteronyssinus"[mh] dogs[mh] dust[mh] fungi[mh] mites[mh] “mite infestations"[mh] pets[mh] "particulate matter"[mh] **CINAHL** (MH "Cats") (MH "Cockroaches") (MH "Dogs") (MH "Dust") (MH "Fungi+") (MH "Mites") (MH "Pets")	apartment cat cats chalk cockroach damp dander dermatophagoides daycare dog dogs dust dust mites fungus fungi home house housing housedust indoor insect mice mite mites moisture mold moldy mould mouldy mouse pet pets pest pests residence residential roach rodent school
Environmental Interventions	**EMBASE (EMTREE)** 'air filter'/exp bed/exp cleaning/exp 'environmental sanitation'/exp 'risk reduction'/exp vacuum/exp 'pests and pest control'/exp 'pest control'/exp ‘indoor residual spraying’/exp **MEDLINE/PubMed (MeSH)**	air filter air filtration air purification allergen reduction bath bathe bathing bed beds bedding clean cleaning

Concept	Controlled Vocabulary	Keywords
	"air filters"[mh] beds[mh] housekeeping[mh] "insect control"[mh] sanitation[mh] vacuum[mh] "pest control"[mh] "rodent control"[mh] ventilation[mh] **CINAHL** (MH "Air Filters") (MH "Beds and Mattresses+") (MH "Home Maintenance") (MH "Pest Control") (MH "Sanitation+") (MH "Vacuum") (MH "Ventilation+")	comforter cover covering covers dehumidifier dehumidify duct cleaning duvet encase exterminate fabric feather futon HEPA high efficiency particulate arrestance hypoallergenic insulation launder laundering laundry linen mattress pet removal pet bathing pillow reduce sanitation sanitize sheet spray spraying sun sunlight remove removal vacuum ventilation wash washing wipe wiping
Carpet/Flooring	**EMBASE (EMTREE)** building/exp **MEDLINE/PubMed (MeSH)** “Floors and floorcoverings”[mh] **CINAHL** (MH “Floors and Floorcoverings”)	carpet* floor* rug rugs wood*

Concept	Controlled Vocabulary	Keywords
Bronchial Thermoplasty	**EMBASE (EMTREE)** 'bronchial thermoplasty device'/exp **MEDLINE/PubMed (MeSH)** No equivalent MeSH terms **CINAHL** No equivalent controlled term	Alair* asthmatx Bronchial thermoplasty bronchiothermoplasty
Bronchial Disease	**EMBASE (EMTREE)** bronchoscopy/exp bronchoscope/exp bronchoconstriction/exp bronchospasm/exp 'bronchus disease'/exp bronchus/exp bronchoplasty/exp 'airway smooth muscle cell'/exp **MEDLINE/PubMed (MeSH)** bronchoscopy[mh] bronchoscopes[mh] bronchoconstriction[mh] or "bronchial spasm"[mh] "bronchial diseases"[mh] bronchi[mh] **CINAHL** (MH "Bronchoscopy") (MH "Bronchoconstriction") (MH "Bronchial Diseases+") (MH "Bronchial Spasm") (MH "Bronchi+")	airway smooth muscle bronchial constriction bronchial spasm bronchoscope bronchoconstriction bronchospasm bronchus constriction bronchus spasm
Radiofrequency ablation terms	**EMBASE (EMTREE)** 'radiofrequency ablation'/exp 'radiofrequency ablation device'/exp 'catheter ablation'/exp 'pulsed radiofrequency treatment'/exp **MEDLINE/PubMed (MeSH)** "Catheter Ablation"[mh] "Pulsed Radiofrequency Treatment"[mh] **CINAHL** (MH "Catheter Ablation")	catheter ablation heat ablation radiofrequency ablation rf ablation thermal ablation thermoplasty

Search Strategies
EMBASE/MEDLINE (Key Question 1 searched via Embase.com)

Set Number	Concept	Search Statement
1	Asthma	asthma/exp OR 'allergic asthma'/exp OR 'asthmatic state'/exp OR 'extrinsic asthma'/exp OR 'intrinsic asthma'/exp OR 'mild intermittent asthma'/exp OR 'mild persistent asthma'/exp OR 'nocturnal asthma'/exp OR 'occupational asthma'/exp OR 'severe persistent asthma'/exp OR asthma*:ti,ab,de
2	Environmental Allergens Household Allergens	(('allergen'/exp OR 'environmental exposure'/exp OR 'health hazard'/exp OR 'disease exacerbation'/exp OR allerg* OR irritant* OR trigger* OR exacerbat* OR sensitiv*) AND ('airborne particle'/exp OR 'cat'/exp OR 'cockroach'/exp OR 'dander'/exp OR 'dog'/exp OR 'dust'/exp OR 'household'/exp OR 'mite'/exp OR 'mould'/exp OR 'pest insect'/exp OR 'pest organism'/exp OR 'pest rodent'/exp OR 'pet animal'/exp OR cat OR cats OR cockroach* OR housedust* OR roach* OR damp* OR dander OR dermatophagoide* OR daycare OR dog OR dogs OR dust* OR home* OR house* OR indoor* OR insect* OR mite OR mites OR mold OR mould OR moldy OR mouldy OR mouse OR mice OR pet OR pets OR pest OR pests OR rodent* OR school* OR moist* OR fungus OR fungi OR chalk*)) OR (('household'/exp OR daycare OR home* OR house* OR indoor* OR residence OR residential OR apartment* OR housing) AND ('airborne particle'/exp OR 'cat'/exp OR 'cockroach'/exp OR 'dander'/exp OR 'dog'/exp OR 'dust'/exp OR 'mite'/exp OR 'mould'/exp OR 'pest insect'/exp OR 'pest organism'/exp OR 'pest rodent'/exp OR 'pet animal'/exp OR cat OR cats OR cockroach* OR housedust* OR roach* OR damp* OR dander OR dermatophagoide* OR dog OR dogs OR dust* OR insect* OR mite OR mites OR mold OR mould OR moldy OR mouldy OR mouse OR mice OR pet OR pets OR pest OR pests OR rodent* OR school* OR moist* OR fungus OR fungi OR chalk*))
3	Environmental Interventions	('air filter'/exp OR bed/exp OR cleaning/exp OR 'environmental sanitation'/exp OR vacuum/exp OR 'pests and pest control'/exp OR 'pest control'/exp OR 'indoor residual spraying'/exp) OR (air NEAR/2 (clean* OR filter* OR filtrat* OR purif*)) OR ventilat* OR insulat* OR (duct* NEAR/2 clean*) OR dehumid* OR bed OR beds OR bedding OR futon* OR clean* OR comforter* OR cover OR covers OR covering* OR duvet* OR encase* OR feather* OR linen* OR fabric OR pillow* OR mattress* OR sanita* OR sanitis* OR sanitiz* OR sheet* OR vacuum* OR sun OR sunlight* OR hypoallergenic OR remove OR removal OR bath* OR exterminat* OR spray* OR ((allergen OR pet OR pets OR pest*) NEAR/5 (reduc* OR avoid* OR eliminat*)) OR wipe OR wiping OR launder OR laundering OR laundry OR hepa OR 'high-efficiency particulate arrestance' OR 'high efficiency particulate arrestance' OR wash OR washing
4	Carpet/Flooring Removal	building/exp OR (carpet* OR floor* OR rug OR rugs OR wood*):ab,ti,de
5	Combine sets	1 AND 2 AND 3
6	Combine sets	1 AND 4
7	Combine sets	5 OR 6
8	Remove unwanted publication types	7 NOT (abstract:nc OR annual:nc OR book/de OR 'case report'/de OR 'case study'/de OR conference:nc OR 'conference abstract':it OR 'conference paper'/de OR 'conference paper':it OR 'conference proceeding':pt OR 'conference review':it OR congress:nc OR editorial/de OR editorial:it OR erratum/de OR letter:it OR note/de OR note:it OR meeting:nc OR sessions:nc OR 'short survey'/de OR symposium:nc)

Set Number	Concept	Search Statement
9	Controlled study filter	8 AND ('randomized controlled trial'/exp OR 'randomized controlled trial' OR 'randomization'/exp OR 'randomization' OR 'double blind procedure'/exp OR 'double blind procedure' OR 'single blind procedure'/exp OR 'single blind procedure' OR 'placebo'/exp OR 'placebo' OR 'latin square design'/exp OR 'latin square design' OR 'crossover procedure'/exp OR 'crossover procedure' OR 'triple blind procedure'/exp OR 'triple blind procedure' OR 'controlled study'/exp OR 'controlled study' OR 'clinical trial'/exp OR 'clinical trial' OR 'comparative study'/exp OR 'comparative study' OR 'cohort analysis'/exp OR 'cohort analysis' OR 'follow up'/exp OR 'follow up' OR 'intermethod comparison'/exp OR 'intermethod comparison' OR 'parallel design'/exp OR 'parallel design' OR 'control group'/exp OR 'control group' OR 'prospective study'/exp OR 'prospective study' OR 'retrospective study'/exp OR 'retrospective study' OR 'case control study'/exp OR 'case control study' OR 'major clinical study'/exp OR 'major clinical study' OR 'evaluation study'/exp OR 'evaluation study' OR random*:de OR random*:ti OR placebo* OR (singl* OR doubl* OR tripl* OR trebl* AND (dummy OR 'blind'/exp OR blind OR sham)) OR 'latin square' OR isrctn* OR actrn* OR (nct* NOT nct))
10	Systematic Review/Meta-analysis filter	8 AND ('research synthesis' OR pooled OR 'systematic review'/exp OR 'systematic review' OR 'meta analysis'/exp OR 'meta analysis' OR (('evidence base' OR 'evidence based'/exp OR 'evidence based' OR methodol* OR systematic OR quantitative* OR studies OR search*) AND ('review'/exp OR 'review' OR 'review'/it)))
11	Combine Sets	9 OR 10
12	Apply Limits	11 AND ('human'/de OR [adolescent]/lim OR [adult]/lim OR [aged]/lim OR [child]/lim OR [infant]/lim OR [middle aged]/lim OR [newborn]/lim OR [preschool]/lim OR [school]/lim OR [very elderly]/lim OR [young adult]/lim)

EMBASE/MEDLINE (Key Question 2 searched via Embase.com)

Set Number	Concept	Search Statement
1	Bronchial Thermoplasty	'bronchial thermoplasty device'/exp OR Alair* OR bronchothermoplast* OR asthmatx* OR bronchiothermoplast* OR (bronchial AND thermoplast*)
2	Asthma	asthma/exp OR asthma*
3	Bronchial disease	'bronchoscopy'/exp OR 'bronchoscope'/exp OR 'bronchoconstriction'/exp OR 'bronchospasm'/exp OR 'bronchus disease'/exp OR 'bronchus'/exp OR 'bronchoplasty'/exp OR 'airway smooth muscle cell'/exp OR bronchoscop* OR bronchoconstrict* OR bronchospasm* OR ((bronchial OR bronchus OR bronchi) NEAR/4 (constrict OR spasm*)) OR “airway smooth muscle”
4	Combine Sets – asthma and/or bronchial disease	2 OR 3
5	Radiofrequency ablation terms	'radiofrequency ablation'/exp OR 'radiofrequency ablation device'/exp OR 'catheter ablation'/exp OR 'pulsed radiofrequency treatment'/exp OR thermoplast* OR ((radiofrequency OR thermal OR heat OR catheter* OR “RF”) NEAR/4 ablat*)
6	Combine sets	4 AND 5
7	Combine sets	1 OR 6
8	Remove unwanted publication types	7 NOT (abstract:nc OR annual:nc OR book/de OR conference:nc OR 'conference abstract':it OR 'conference paper'/de OR 'conference paper':it OR 'conference proceeding':pt OR 'conference review':it OR congress:nc OR editorial/de OR editorial:it OR erratum/de OR letter:it OR note/de OR note:it OR meeting:nc OR sessions:nc OR 'short survey'/de OR symposium:nc)
9	Limit 8 to Humans;	8 AND [humans]/lim

EMBASE.com Syntax:

*	=	truncation character (wildcard)
NEAR/*n*	=	search terms within a specified number (*n*) of words from each other in any order
NEXT/*n*	=	search terms within a specified number (*n*) of words from each other in the order specified
/	=	search as a subject heading
exp	=	"explodes" controlled vocabulary term (e.g., expands search to all more specific related terms in the vocabulary's hierarchy)
mj	=	denotes a term that has been searched as a major subject heading
:de	=	search in the descriptors field (controlled terms and keywords)
:lnk	=	floating subheading
/lim	=	limiter
:it,pt.	=	source item or publication type
:ti.	=	limit to title
:ti,ab.	=	limit to title and abstract fields

PubMed (PreMEDLINE)

PubMed In Process Citations (Key Question 1)

Set Number	Concept	Search Statement
1	Asthma[mh] OR asthma*	Asthma[mh] OR asthma*
2	Environmental Allergens	("Allergens"[Mesh] OR "Environmental Exposure"[Mesh] OR allerg*[tiab] OR irritant*[tiab] OR trigger*[tiab] OR exacerbat*[tiab] OR sensitiv*[tiab]) AND ("Particulate Matter"[Mesh] OR "Cats"[Mesh] OR "Dander"[Mesh] OR "Dogs"[Mesh] OR "Cockroaches"[Mesh] OR "Dust"[Mesh] OR "Antigens, Dermatophagoides"[Mesh] OR "Dermatophagoides pteronyssinus"[Mesh] OR "Dermatophagoides farinae"[Mesh] OR "Mites"[Mesh] OR "Mite Infestations"[Mesh] OR "Fungi"[Mesh] OR "Pets"[Mesh] OR cat[tiab] OR cats[tiab] OR cockroach*[tiab] OR housedust*[tiab] OR roach*[tiab] OR damp*[tiab] OR dander[tiab] OR dermatophagoide*[tiab] OR daycare[tiab] OR dog[tiab] OR dogs[tiab] OR dust*[tiab] OR home*[tiab] OR house*[tiab] OR indoor*[tiab] OR insect*[tiab] OR mite[tiab] OR mites[tiab] OR mold[tiab] OR mould[tiab] OR moldy[tiab] OR mouldy[tiab] OR mouse[tiab] OR mice[tiab] OR pet[tiab] OR pets[tiab] OR pest[tiab] OR pests[tiab] OR rodent*[tiab] OR school*[tiab] OR moist*[tiab] OR fungus[tiab] OR fungi[tiab] OR chalk*[tiab])
	Household Allergens	OR (daycare OR home* OR house* OR indoor* OR residence OR residential OR apartment* OR housing) AND("Particulate Matter"[Mesh] OR "Cats"[Mesh] OR "Dander"[Mesh] OR "Dogs"[Mesh] OR "Cockroaches"[Mesh] OR "Dust"[Mesh] OR "Antigens, Dermatophagoides"[Mesh] OR "Dermatophagoides pteronyssinus"[Mesh] OR "Dermatophagoides farinae"[Mesh] OR "Mites"[Mesh] OR "Mite Infestations"[Mesh] OR "Fungi"[Mesh] OR "Pets"[Mesh] OR cat[tiab] OR cats[tiab] OR cockroach*[tiab] OR housedust*[tiab] OR roach*[tiab] OR damp*[tiab] OR dander[tiab] OR dermatophagoide*[tiab] OR dog[tiab] OR dogs[tiab] OR dust*[tiab] OR insect*[tiab] OR mite[tiab] OR mites[tiab] OR mold[tiab] OR mould[tiab] OR moldy[tiab] OR mouldy[tiab] OR mouse[tiab] OR mice[tiab] OR pet[tiab] OR pets[tiab] OR pest[tiab] OR pests[tiab] OR rodent*[tiab] OR school*[tiab] OR moist*[tiab] OR fungus[tiab] OR fungi[tiab] OR chalk*[tiab])

Set Number	Concept	Search Statement
3	Environmental Interventions	"Air Filters"[Mesh] OR "Beds"[Mesh] OR "Housekeeping"[Mesh] OR "Sanitation"[Mesh] OR "Vacuum"[Mesh] OR "Pest Control"[Mesh] OR "Insect Control"[Mesh] OR "Rodent Control"[Mesh] OR ventilation[Mesh] OR (air[tiab] AND (clean*[tiab] OR filter*[tiab] OR filtrat*[tiab] OR purif*[tiab])) OR ventilat*[tiab] OR insulat*[tiab] OR (duct*[tiab] AND clean*[tiab]) OR dehumid*[tiab] OR bed*[tiab] OR futon*[tiab] OR clean*[tiab] OR comforter*[tiab] OR cover[tiab] OR covers[tiab] OR covering*[tiab] OR duvet*[tiab] OR encase*[tiab] OR feather*[tiab] OR linen*[tiab] OR fabric[tiab] OR pillow*[tiab] OR mattress*[tiab] OR sanita*[tiab] OR sanitis*[tiab] OR sanitiz*[tiab] OR sheet*[tiab] OR vacuum*[tiab] OR hypoallergenic*[tiab] OR exterminat*[tiab] OR spray*[tiab] OR sun[tiab] [tiab] OR sunlight*[tiab] OR bath*[tiab] OR ((allergen*[tiab] OR pet[tiab] OR pets[tiab] OR pest*[tiab]) AND (reduc*[tiab] OR avoid*[tiab] OR eliminat*[tiab] OR remove OR removal)) OR wipe[tiab] OR wiping[tiab] OR launder[tiab] OR laundering[tiab] OR laundry[tiab] OR hepa[tiab] OR 'high-efficiency particulate arrestance'[tiab] OR 'high efficiency particulate arrestance'[tiab] OR wash[tiab] OR washing[tiab]
4	Carpet/Flooring removal	"Floors and Floorcoverings"[Mesh] OR (carpet*[tiab] OR floor*[tiab] OR rug[tiab] OR rugs[tiab] OR wood*[tiab])
5	Combine sets	1 AND 2 AND 3
6	Combine sets	1 AND 4
7	Combine sets	5 OR 6
8	Remove unwanted publication types	7 NOT (case reports[pt] OR comment[pt] OR editorial[pt] OR letter[pt] OR news[pt] OR "Textbooks" [pt] OR "Book Reviews"[pt]OR "Book Illustrations"[pt] OR book OR books OR textbook*)
9	In process citations	8 AND ("inprocess"[sb] OR publisher[sb] OR pubmednotmedline[sb])

PubMed In Process Citations (Key Question 2)

Set Number	Concept	Search Statement
1	Bronchial Thermoplasty	Alair* OR bronchothermoplast* OR asthmatx* OR bronchiothermoplast* OR (bronchial AND thermoplast*)
2	Asthma	Asthma[mh] OR asthma*
3	Bronchial disease	"Bronchoscopy"[Mesh] OR "Bronchoscopes"[Mesh] OR "Bronchoconstriction"[Mesh] OR "Bronchial Spasm"[Mesh] OR "Bronchial Diseases"[Mesh] OR "Bronchi"[Mesh] OR bronchoscop* OR bronchoconstrict* OR bronchospasm* OR ((bronchial[tiab] OR bronchus[tiab] OR bronchi[tiab]) AND (constrict[tiab] OR spasm*[tiab])) OR “airway smooth muscle”
4	Combine Sets – asthma and/or bronchial disease	2 OR 3
5	RF ablation terms	"Catheter Ablation"[Mesh] OR "Pulsed Radiofrequency Treatment"[Mesh] OR thermoplast* OR ((radiofrequency OR thermal OR heat OR catheter*) AND ablat*) OR “rf ablation”
6	Combine sets	4 AND 5
7	Combine sets	1 OR 6
8	Remove unwanted publication types	7 NOT (comment[pt] OR editorial[pt] OR letter[pt] OR news[pt] OR "Textbooks" [pt] OR "Book Reviews"[pt]OR "Book Illustrations"[pt] OR book OR books OR textbook*)
9	In process citations	8 AND ("inprocess"[sb] OR publisher[sb] OR pubmednotmedline[sb])

PubMed Syntax:

*	=	truncation character (wildcard)
[mh]/[MesH]	=	controlled vocabulary term
[sb]	=	subset
[ti]	=	limit to title field
[tiab]	=	limit to title and abstract fields
[tw]	=	text word

CINAHL

CINAHL (Key Question 1)

English language, human, exclude MEDLINE records

Set Number	Concept	Search Statement
1	Asthma	(MH "Asthma+") OR (MH "Asthma, Occupational") OR asthma*
2	Household allergens	((MH "Allergens+") OR (MH "Disease Exacerbation") OR (MH "Environmental Exposure+") OR allerg* OR irritant* OR trigger* OR exacerbat* OR sensitiv*) AND ((MH "Dogs") OR (MH "Cats") OR (MH "Pets") OR (MH "Cockroaches") OR (MH "Dust") OR (MH "Mites") OR (MH "Fungi+") OR cat OR cats OR cockroach* OR housedust* OR roach* OR damp* OR dander OR dermatophagoide* OR daycare OR dog OR dogs OR dust* OR home* OR house* OR indoor* OR insect* OR mite OR mites OR mold OR mould OR moldy OR mouldy OR mouse OR mice OR pet OR pets OR pest OR pests OR rodent* OR school* OR moist* OR fungus OR fungi OR chalk*)
3	Environmental Interventions/Household Allergens	((MH "Air Filters") OR (MH "Beds and Mattresses+") OR (MH "Home Maintenance") OR (MH "Sanitation+") OR (MH "Vacuum") OR (MH "Pest Control") OR (MH "Ventilation+") OR (air AND (clean* OR filter* OR filtrat* OR purif*)) OR ventilat* OR insulat* OR (duct* AND clean*) OR dehumid* OR bed OR beds OR bedding OR futon* OR clean* OR comforter* OR cover OR covers OR covering* OR duvet* OR encase* OR feather* OR linen* OR fabric OR pillow* OR mattress* OR sanita* OR sanitis* OR sanitiz* OR sheet* OR vacuum* OR sun OR sunlight* OR hypoallergenic OR remove OR removal OR bath* OR exterminat* OR spray* OR ((allergen OR pet OR pets OR pest*) AND (reduc* OR avoid* OR eliminat*)) OR wipe OR wiping OR launder OR laundering OR laundry OR hepa OR “high-efficiency particulate arrestance” OR “high efficiency particulate arrestance” OR wash OR washing
4	Carpet/Flooring Removal	(MH "Floors and Floorcoverings") OR carpet* OR floor* OR rug OR rugs OR wood*
5	Combine sets Key Question 1	1 AND 2 AND 3
6	Combine sets Key Question 2	1 AND 4
7	Combine sets Key Question 1 OR Key Question 2	5 OR 6
8	Remove Medline records/ limit to academic journals	

CINAHL (Key Question 2)

Set Number	Concept	Search Statement
1	Bronchial Thermoplasty	Alair* OR bronchothermoplast* OR asthmatx* OR bronchiothermoplast* OR (bronchial AND thermoplast*)
2	Asthma	(MH "Asthma+") OR asthma*
3	Bronchial disease	(MH "Bronchoscopy") OR (MH "Bronchoconstriction") OR (MH "Bronchial Diseases+") OR (MH "Bronchial Spasm") OR (MH "Bronchi+") OR bronchoscop* OR bronchoconstrict* OR bronchospasm* OR ((bronchial OR bronchus OR bronchi) AND (constrict* OR spasm*)) OR “airway smooth muscle”
4	Combine Sets – asthma and/or bronchial disease	2 OR 3

Set Number	Concept	Search Statement
5	RF ablation terms	(MH "Catheter Ablation") OR thermoplast* OR ((radiofrequency OR thermal OR heat OR catheter*) AND ablat*) OR “rf ablation” OR “rf-ablation”
6	Combine sets	4 AND 5
7	Combine sets	1 OR 6
8	Remove Medline records	

CINAHL Syntax:

…+ = explode

* = truncation character (wildcard)

N*n* = search terms within a specified number (*n*) of words from each other in any order

TI = limit to title field

AB = limit to title and abstract fields

MH = MeSH heading

MJ = MeSH heading designated as major topic

PT = publication type

Appendix B. Excluded Studies

Belice PJ, Becker EA. Effective education parameters for trigger remediation in underserved children with asthma: a systematic review. J Asthma. 2016 Jun 15;1-16. Also available: http://dx.doi.org/10.1080/02770903.2016.1198374. PMID: 27304997. **Does not address Key Question**

Ryan DM, Fowler SJ, Niven RM. Reduction in peripheral blood eosinophil counts after bronchial thermoplasty. J Allergy Clin Immunol. 2016 Mar 4. Also available: http://dx.doi.org/10.1016/j.jaci.2015.11.044. PMID: 26953157. **Single-arm study; no adverse events**

Zhou JP, Feng Y, Wang Q, et al. Long-term efficacy and safety of bronchial thermoplasty in patients with moderate-to-severe persistent asthma: A systemic review and meta-analysis. J Asthma. 2016 Jan 2;53(1):94-100. Also available: http://dx.doi.org/10.3109/02770903.2015.1065424. **Systematic review of included individual studies**[1-3]

Ansarin K, Attaran D, Jamaati H, et al. Approach to patients with severe asthma: a consensus statement from the Respiratory Care Experts' Input Forum (RC-EIF), Iran. Tanaffos. 2015;14(2):73-94. PMID: 26528362. **Systematic review of included individual studies**[1-3]

Chakir J, Haj-Salem I, Gras D, et al. Effects of bronchial thermoplasty on airway smooth muscle and collagen deposition in asthma. Ann Am Thorac Soc. 2015 Sep 1;12(11):1612-8. Also available: http://dx.doi.org/10.1513/AnnalsATS.201504-208OC. PMID: 26325484. **Single-arm study; no adverse events**

Denner DR, Doeing DC, Hogarth DK, et al. Airway inflammation after bronchial thermoplasty for severe asthma. Ann Am Thorac Soc. 2015 Sep 1;12(9):1302-9. Also available: http://dx.doi.org/10.1513/AnnalsATS.201502-082OC. **Single-arm study; no adverse events**

Dheda K, Koegelenberg CF, Esmail A, et al. Recommendations for the use of bronchial thermoplasty in the management of severe asthma. S Afr Med J. 2015 Sep;105(9):726-32. PMID: 26428967. **Systematic review of included individual studies**[1-3]

Grant MD, Blue Cross Blue Shield Association. Bronchial thermoplasty for treatment of inadequately controlled severe asthma. Technol Eval Cent Asses Program Exec Summ. 2015 Mar;29(12):1-5. PMID: 25962190. **Systematic review of included individual studies**[1-3]

Torrego A, Sola I, Munoz AM, et al. Bronchial thermoplasty for moderate or severe persistent asthma in adults. Cochrane Database Syst Rev. 2014;3(3):CD009910. PMID: 24585221. **Systematic review of included individual studies**[1-3]

Jassal MS, Diette GB, Dowdy DW. Cost-consequence analysis of multimodal interventions with environmental components for pediatric asthma in the state of Maryland. J Asthma. 2013 Aug;50(6):672-80. Also available: http://dx.doi.org/10.3109/02770903.2013.792351. PMID: 23614791. **Does not address Key Question**

Sauni R, Uitti J, Jauhiainen M, et al. Remediating buildings damaged by dampness and mould for preventing or reducing respiratory tract symptoms, infections and asthma (Review). Evidence-Based Child Health. 2013 May;8(3):944-1000. Also available: http://dx.doi.org/10.1002/ebch.1914. PMID: 23877912. **Does not address Key Question**

Singh M, Jaiswal N. Dehumidifiers for chronic asthma. Cochrane Database Syst Rev. 2013;(6):CD003563. PMID: 23760885. **Does not address Key Question**

Castro M, Rubin A, Laviolette M, et al. Persistence of effectiveness of bronchial thermoplasty in patients with severe asthma. Ann Allergy Asthma Immunol. 2011 Jul;107(1):65-70. Also available: http://dx.doi.org/10.1016/j.anai.2011.03.005. PMID: 21704887. **Superseded by related study with longer followup**[4]

Lanphear BP, Hornung RW, Khoury J, et al. Effects of HEPA air cleaners on unscheduled asthma visits and asthma symptoms for children exposed to secondhand tobacco smoke. Pediatrics. 2011 Jan;127(1):93-101. Also available: http://dx.doi.org/10.1542/peds.2009-2312. PMID: 21149427. **Irritant (smoke) not in scope**

Townsend KJ, George M. What is the evidence that environmental remediation programs are effective in urban children with allergic asthma? An integrated review. J Asthma Allergy Educ. 2011 Dec;2(6):295-305. Also available: http://dx.doi.org/10.1177/2150129711418826. **Does not address Key Question**

Wu Q, Xing Y, Zhou X, et al. Meta-analysis of the efficacy and safety of bronchial thermoplasty in patients with moderate-to-severe persistent asthma. J Int Med Res. 2011;39(1):10-22. PMID: 21672303. **Systematic review of included individual studies**[1-3]

Krieger J, Jacobs DE, Ashley PJ, et al. Housing interventions and control of asthma-related indoor biologic agents: a review of the evidence. J Public Health Manag Pract. 2010 Sep-Oct;16(5 Suppl):S11-20. PMID: 20689369. **Systematic review**

Tzeng LF, Chiang LC, Hsueh KC, et al. A preliminary study to evaluate a patient-centred asthma education programme on parental control of home environment and asthma signs and symptoms in children with moderate-to-severe asthma. J Clin Nurs. 2010 May;19(9):1424-33. PMID: 20500352. **Education only**

Buczylko K, Korzycka-Zaborowska B, Michalak A. Influence of the acaricide - set on the improvement of mite allergy symptoms. Alergia Astma Immunologia. 2008 Mar;13(1):42-52. **Does not provide adequate data on asthma outcomes or allergen outcomes**

Gotzsche PC, Johansen HK. House dust mite control measures for asthma. Cochrane Database Syst Rev. 2008;(2):CD001187 Also available: http://dx.doi.org/10.1002/14651858.CD001187.pub3. PMID: 18425868. **Systematic review**

Howden-Chapman P, Pierse N, Nicholls S, et al. Effects of improved home heating on asthma in community dwelling children: Randomised controlled trial. BMJ. 2008 Oct 11;337(7674):852-5. Also available: http://dx.doi.org/10.1136/bmj.a1411. PMID: 18812366. **Does not focus on allergen removal**

Shedd AD, Peters JI, Wood P, et al. Impact of home environment characteristics on asthma quality of life and symptom scores. J Asthma. 2007 Apr;44(3):183-7. Also available: http://dx.doi.org/10.1080/02770900701209699. PMID: 17454335. **Not an RCT**

Bernstein JA, Bobbitt RC, Levin L, et al. Health effects of ultraviolet irradiation in asthmatic children's homes. J Asthma. 2006 May;43(4):255-62. Also available: http://dx.doi.org/10.1097/01.ede.0000209440.94875.42. PMID: 16809237. **Due to carry over effects, data analysis focused on the first treatment period; n<10**

Takaro TK, Krieger JW, Song L. Effect of environmental interventions to reduce exposure to asthma triggers in homes of low-income children in Seattle. J Expo Anal Environ Epidemiol. 2004;14 Suppl 1:S133-43. Also available: http://dx.doi.org/10.1038/sj.jea.7500367. PMID: 15118754. **Nonclinical data from Krieger study**

Hasan RA, Zureikat GY, Camp J, et al. The positive impact of a disease management program on asthma morbidity in inner-city children. Pediatr Asthma Allergy Immunol. 2003 Sep;16(3):147-54. **Only education**

Kilburn S, Lasserson TJ, McKean M. Pet allergen control measures for allergic asthma in children and adults. Cochrane Database Syst Rev. 2001;CD002989. PMID: 12535446. **Systematic review**

Rijssenbeek Nouwens LH, Oosting AJ, De Monchy JG, et al. The effect of anti-allergic mattress encasings on house dust mite-induced early- and late-airway reactions in asthmatic patients. A double-blind, placebo-controlled study. Clin Exp Allergy. 2002;32(1):117-25. Also available: http://dx.doi.org/10.1046/j.0022-0477.2001.01256.x. PMID: 12002728. **Preliminary report of included study**[5]

Singh M, Bara A, Gibson P. Humidity control for chronic asthma. Cochrane database of systematic reviews. 2002. PMID: 12076485. **Does not address Key Question**

Gotzsche PC, Hammarquist C, Burr M. House dust mite control measures in the management of asthma: Meta-analysis. Br Med J. 1998 Oct 24;317(7166):1105-10. PMID: 9784442. **Systematic review**

Wood RA, Johnson EF, Van Natta ML, et al. A placebo-controlled trial of a HEPA air cleaner in the treatment of cat allergy. Am J Respir Crit Care Med. 1998;158(1):115-20. PMID: 9655716. **<85% patients with asthma, data not reported separately**

Ehnert B, Lau-Schadendorf S, Weber A, et al. Reducing domestic exposure to dust mite allergen reduces bronchial hyperreactivity in sensitive children with asthma. J Allergy Clin Immunol. 1992 Jul;90(1):135-8. PMID: 1629503. **Fewer than 10 patients enrolled**

Appendix C. Evidence Tables

Key Question 1: Nonpharmacologic Management of Asthma: Evidence Tables for Individual Interventions

Nonpharmacologic Management of Asthma: Evidence Tables for Acaricide (Dust Mite Pesticide) Studies

Table C-1. Study characteristics of acaricide (dust mite pesticide) studies

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Bahir et al. 1997[6]	Acaricide (Acardust: esdepallethin/piperonyl butoxide) + avoidance vs. Placebo + avoidance vs. avoidance measures alone Acaricide or placebo were applied to floors and mattresses at baseline and after 3 months	House dust mites: Combined Der p 1 and Der f 1 as measured with Acarex test	*Type of study:* RCT *Total population:* N=62 participants, 46 completed Acardust: 13 Placebo: 17 Avoidance: 16 *Attrition: 26%* *Setting:* Home *Country:* Israel *Followup:* 6 months	*Age (mean [SD]):* Acardust: 9.2 (2.4) Range: 6.5–13 Placebo: 10.4 (2.6) Range: 6–15 Avoidance: 11.8 (3.2) Range: 7–16.5 *% Male:* NR *Race:* NR *Homeownership:* NR *Geographic environment:* Sites described as being in a "radius of 15 km along the seashore, [with] similar weather conditions with respect to air temperature and humidity."	*Sensitization:* HDM: 100% (Skin prick test positive wheal >3.0 mm) *Asthma severity:* Mild to moderate (Asthma score >2) *Baseline spirometry (FEV_1 predicted):* Acardust: 72% Placebo: 75% Avoidance: 72% *Mean duration of asthma, year (SD):* Acardust: 7.3 (2.7) Placebo: 6.8 (2.6) Avoidance: 9.5 (4.3) *Carpeted living room:* Acardust: 38% Placebo: 53% Avoidance: 25% $Chi^2(2, 46)=9.271$; p=0.0097; presence of carpet statistically different among groups[a]

Table C-1. Study characteristics of acaricide (dust mite pesticide) studies (continued)

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
van der Heide et al. 1997[7]	Acaricide (Acarosan) vs. Placebo (detergent) vs. Mattress covers Acaricide or placebo was applied to textile-covered floors and mattresses. Non-textile-covered floors were not treated.	Der p 1	*Type of study:* Quasi-RCT; participants randomized to acaricide or placebo, with participants who refused chemical intervention given mattress casings. Acaricide: 21 Placebo: 19 Mattress: 19 *Attrition: NR* *Setting:* Home *Country:* Netherlands *Followup:* 1 year	*Age (mean [SD]):* Acaricide: 31.5 (8.8) Placebo: 30.1 (7.2) Mattress: 32.3 (5.8) *% Male:* Acaricide: 44% Placebo: 53% Mattress: 42% *Race:* Not specified *Homeownership:* Not specified *Geographic environment:* Not described	*Sensitization:* Positive sensitization defined as histamine equivalent wheal size (HEWS, wheal size with allergen/wheal size with standard histamine) ≥0.7 HDM: 100% *Asthma severity:* FEV_1 % predicted, mean (SD) Acaricide: 88.7 (13.6) Placebo: 89.4 (13.3) Mattress: 92.4 (12.8) PC_{20} histamine (mg/ml), mean (95% CI) Acaricide: 1.97 (1.22 to 3.16) Placebo: 2.23 (1.19 to 4.15) Mattress: 3.87 (2.24 to 6.62) Smokers: 16.9% Cigarette smoke exposed in home: 22% Animals in home: Acaricide: 43% Placebo: 58% Mattress: 58% Floor covering in bedroom: Acaricide: 77% Placebo: 89% Mattress: 52%* p<0.05 compared to other two groups.
Chang et al. 1996[8]	Acaricide (Acarosan: benzyl benzoate + usual mite control vs. Usual mite control (no placebo treatment given) Acarosan was applied to mattresses, bedroom carpet, and carpet in the most commonly used room Usual mite control included vinyl barriers on mattresses and pillows, vacuuming at least 1 x week, and washing bed linens in hot (>58℃) water.	House dust mite allergens Der p 1 and Der f 1	*Type of study:* RCT *Total population:* N=26 participants, 11 children, 15 adults Acarosan: 12 Control: 14 *Attrition:* 0% *Setting:* Home *Country:* Canada *Followup:* 3 months	*Demographic data:* NR; age ranges for adults and children not described *Geographic environment:* Not specified, patients enrolled in Vancouver and Winnipeg	*Sensitization:* HDM: 100% (Skin prick test positive) *Asthma severity:* NR *Baseline spirometry (FEV_1), % mean (SD):* Acarosan: 88% (11%) Control: 85% (11%) PEFR, L/min, mean (SD) Acarosan: 402 (69) Control: 381 (97) *PC20, mg/mL, mean (SD)* Acarosan: 0.76 (1.93) Control: 0.47 (5.62)

Table C-1. Study characteristics of acaricide (dust mite pesticide) studies (continued)

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Geller-Bernstein et al. 1995[9]	Acaricide (Acardust) vs. placebo Acaricide or placebo were applied to bedrooms at baseline and after 3 months	House dust mite allergens Der p and Der f	*Type of study:* RCT *Total population:* N=35 Acardust: 18 Placebo: 17 *Attrition:* 23% *Setting:* Home *Country:* Israel *Followup:* 6 months	*Age (mean [SD]):* Acardust: 9.74 (2.64) Placebo: 8.07 (2.58) Range 4-12 years *% Male:* 65.7% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* HDM: 100% (Skin prick test positive) *Asthma severity:* NR *Mean duration of asthma, months (SD):* Acardust: 83.7 (39.4) Placebo: 63.9 (40.9) *Comorbidity:* Rhinitis: Acardust: 94% Placebo: 88%
Sette et al. 1994[10]	Acarosan vs. placebo vs. no intervention Applied to mattresses at baseline and after 3 months	House dust mite allergen Der p 1	*Type of study:* RCT *Total population:* N=32 Acarosan: 14 Placebo: 12 Control: 8 *Attrition:* NR *Setting:* Home *Country:* Italy *Followup:* 3 months	*Age (mean [95% CI]):* Acarosan: 12.5 (1.71) Placebo: (1.6) (6.7) Range: 13-58 years *% Male:* 69% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* HDM: 100% skin prick test *Asthma severity:* NR *Comorbidity*: NR
Dietemann et al. 1993[11]	Acarosan vs. placebo Applied to carpets, upholstery, and mattresses at baseline and after 6 months	House dust mite allergens Der p 1 and Der f 1	*Type of study:* RCT *Total population:* N=26 Acardust: 14 Placebo: 12 *Attrition:*12% *Setting:* Home *Country:* France *Followup:* 12 months	*Age (mean [95% CI]):* Acardust: 36.8 (11) Placebo: 35.4 (6.7) Range: 13-58 years *% Male:* 35.7% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* *Dp*-specific IgE (RAST), mean (95% CI) Acardust: 11.8 (2.7) Placebo: 14 (1.6) *Dp*-intradermal tests, mm, mean (95% CI) Acardust: 3.45 (0.3) Placebo: 3.72 (0.25) *Asthma severity:* Mean baseline FEV_1 (95% CI) Acardust: 63.45 (14.32) Placebo: 72.73 (16.4) Mean baseline FEF_{25-75} (95% CI) Acardust: 48 (16) Placebo: 56.34 (15.5) Mean morning PEFR (95% CI) Acardust: 67.85 (13.6) Placebo: 75.38 (11.6) Mean evening PEFR (95% CI) Acardust: 67.14 (13.3) Placebo: 79.25 (11.6) *Mean duration of asthma, years (95% CI):* Acardust: 17.4 (10.6)

Table C-1. Study characteristics of acaricide (dust mite pesticide) studies (continued)

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
					Placebo: 13 (6.4)
Reiser et al. 1990[12]	Natamycin vs. placebo Natamycin (500 mg/dose, Tymasil) or placebo spray applied to mattresses every 2 weeks for 3 months, for 6 total applications	House dust mite allergen Der p 1	*Type of study:* RCT *Total population:* 46 *Attrition:*NR *Setting:* Home *Country:* U.K. *Followup:* 3 months	*Age (mean):* NR *Age (range):* 5-16 *% Male:* 76% *Race:* NR *Homeownership:* 84% *Geographic environment:* NR	*Sensitization:* HDM 100% skin prick test *Asthma severity:* Described as ranging from intermittent to chronic severe; no additional data reported *Comorbidity:* NR *Carpet:* 82% *Pets:* 36%

[a] Chi^2 test conducted by ECRI-Penn EPC to determine whether groups varied on important baseline factors.

CI=confidence interval; Der f 1=dust mite allergen, *Dermatophagoides farina* allergen 1; Der p 1=dust mite allergen, *Dermatophagoides pteronyssinus* allergen 1; FEV_1=forced expiratory volume in one second; FEF_{25-75}=average forced expiratory flow during the middle 25–75% portion of forced vital capacity (FVC); HDM=house dust mite; IgE=immunoglobulin E; PEFR=peak expiratory flow rate; PC20=provocative concentration 20, assesses airway hyper-responsiveness; RAST=radioallergosorbent test; SD=standard deviation

Table C 2. Outcomes of acaricide (dust mite pesticide) studies

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Bahir et al. 1997[6]	NR	NR	**Spirometry:** Between-group analysis showed no difference between treatments for any outcomes (data shown graphically; p>0.05) **FEV_1**, % mean (SD) Baseline: 73.5 (13.2)% 6 months: 78.2 (14.7)% Did not vary statistically **Morning PEFR**, mean (SD) Baseline: 245 (85) 6 months: 282 (82) Did not vary statistically **Evening PEFR**, mean (SD Baseline: 253 (85) 6 months: 291 (83) Did not vary statistically	NR	**Symptom scores**[a], mean (SD): Between-group analysis showed no difference between treatments (data shown graphically; p>0.05) Baseline: 2.6 (2) 6 months: 1.5 (1.5) p<0.001	Acarex score (mean [SD]) improved within both treatment groups over time Baseline: 3.5 (0.6) 6 months: 2.9 (0.9) p<0.001. Between-group analysis showed no difference between treatments (data shown graphically; p>0.05)
van der Heide et al. 1997[7]	NR	NR	**FEV_1 and Vital Capacity:** Did not differ between groups; data not shown **PC_{20} histamine:** Improved statistically significantly in the Acaricide and Mattress cover groups (p<0.05; data shown graphically); improvements described as small and less than one doubling dose. Between-group comparison not described.	NR	NR	NR

Table C-2. Outcomes of acaricide (dust mite pesticide) studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Chang et al. 1996[8]	NR	NR	**Spirometry at 3-month followup:** No difference between treatments or over time was reported for any outcomes. Test statistics NR. ***FEV_1**, % mean (SD)* Acarosan: 87% (20%) Control: 90% (15%) ***PEFR**, L/min, mean (SD)* Acarosan: 411 (75) Control: 383 (100) ***PC_{20}**, mg/mL, mean (SD)* Acarosan: 0.87 (2.29) Control: 0.82 (3.84)	NR	NR	Mite Allergen (Der p 1 + Der f 1, mcg/g dust) Mattress Baseline: Acarosan: 2.17 (2.64) Control: 1.68 (2.22) 3 months: Acarosan: 0.06 (1.12) Control: 0.28 (1.32) Allergen levels reduced in both groups at 3 month followup relative to baseline ($p<0.05$); no difference between groups Floor Baseline: Acarosan: 2.38 (2.64) Control: 2.05 (2.05) 3 months: Acarosan: 0.50 (1.71) Control: 1.10 (2.17) Allergen levels reduced only in the Acarosan group at 3 month followup relative to baseline ($p<0.05$); no difference between groups.

Table C-2. Outcomes of acaricide (dust mite pesticide) studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Geller-Bernstein et al. 1995[9]	NR	NR	NR	NR	Data from 6-month followup Mean symptom score (Lower score = fewer symptoms) **Daily activity disruption** Acardust: 0.13 Placebo: 0.27 p=0.02 **Parent evaluation of severity** Acardust: 5.47 Placebo: 6.60 p=0.001 **Doctor evaluation of severity** Acardust: 4.20 Placebo: 6.00 p=0.04 **Wheezing frequency** Acardust: 0.67 Placebo: 0.73 p=0.1, n.s.	Mite Allergen (Der f 1, mcg/g dust) Allergen counts decreased to a greater degree in the Acardust group (p=0.02) Mean (SD) from baseline and 6-month followup Baseline: Acardust: 10.05 (13.74) Placebo: 6.01 (8.01) 6 months: Acardust: 4.15 (6.51) Placebo: 3.01 (4.33)

Table C-2. Outcomes of acaricide (dust mite pesticide) studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Sette et al. 1994[10]	NR	NR	**PC_{20}** Change from baseline (mean, SEM) Study period 1 Acarosan: -2.39 (1.53) mg/mL Placebo: -0.07 (1.05) Control: -5.75 (4.42) Study period 2 Acarosan: -1.95 (1.19) Placebo: -1.82 (0.74) Control: -3.84 (3.12) p=n.s.	NR	NR	Serum IgE Change from baseline (no measure of variance provided) Study period 1 Acarosan: -1.41 Placebo: 0.45 Control: 9.60 p=n.s. Study period 2 Acarosan: 1.10 Placebo: -0.50 Control: 0.50 p=n.s. Nasal IgE Study period 1 Acarosan: 0.40 Placebo: 0.49 Control: 1.62 p=n.s. Study period 2 Acarosan: 1.37 Placebo: 2.62 Control: -0.02 p=n.s.

Table C-2. Outcomes of acaricide (dust mite pesticide) studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Dietemann et al. 1993[11]	NR	NR	Data reported as % change from baseline **FEV_1** Acarosan: +14% Placebo: +0.08% p: n.s. **FEF_{25-75}** Acarosan: +24.6% Placebo: +12% p: n.s. **Mean morning PEFR** Acarosan: +0.05% Placebo: -0.014% p: n.s. **Mean evening PEFR** Acarosan: +0.03% Placebo: -0.02% p: n.s.	NR	NR	Data reported as % change from baseline Quantitative guanine (mattress): Acarosan: -0.03% Placebo: -35% p: n.s. Der p 1 + Der f 1 (mattress): Acarosan: -19.7% Placebo: -17% p: n.s. Der p 1 + Der f 1 (carpet): Acarosan: -74% Placebo: -27% p: n.s. Der p 1 + Der f 1 (other): Acarosan: -67% Placebo: -61% p<0.05
Reiser et al. 1990[12]	NR	NR	**Peak flow and FEV_1:** No significant difference between groups (data reported in graph)	NR	**Clinical symptoms** (components not specified): No significant difference between groups (data reported in graph)	Mite allergen (Der p 1): Geometric mean difference from log baseline to log followup Natamycin: 2659 Placebo: 1009 p=n.s.

[a] Symptoms assessed by subjective symptom diary, 12-point scale with lower scores showing fewer symptoms. Validation of diary not described

[b] Symptoms assessed in similar manner as above, but total points not described. Lower scores indicate fewer symptoms. Validation of diary not described.

Der f 1=dust mite allergen; *Dermatophagoides farina* allergen 1; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; FEV_1=forced expiratory volume in one second; $FEF_{25-75=}$average forced expiratory flow during the middle 25–75% portion of forced vital capacity (FVC); n.s.=not significant; PC_{20}=provocative concentration 20; assesses airway hyper-responsiveness; PEFR=peak expiratory flow rate

Table C-3. Risk of bias of acaricide (dust mite pesticide) RCTs

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Bahir et al. 1997[6]	Unclear	Unclear	Low	Unclear	High	Low	High	Insufficient description of randomization; placebo used; unclear if outcome assessors were blinded; 26% attrition; study funded by acaricide manufacturer
Chang et al. 1996[8]	Unclear	Unclear	High	High	Low	Low	Low	Insufficient description of randomization; no blinding; all patients completed followup
Geller-Bernstein et al. 1995[9]	Unclear	Unclear	Low	Low	High	Low	Low	Insufficient description of randomization; placebo used; 23% attrition
Sette et al. 1994[10]	Unclear	Unclear	Low	Low	Unclear	Low	Low	Insufficient description of randomization; placebo used; attrition not reported
Dietemann et al. 1993[11]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo used;12% attrition
Reiser et al. 1990[12]	Unclear	Unclear	Low	Low	Unclear	Low	High	Insufficient description of randomization; placebo used; attrition not reported; study funded by acaricide manufacturer

Table C-4. Risk of bias of acaricide (dust mite pesticide) non-RCT

Study	Representativeness of the Study Population	Ascertainment of Exposure	Comparability of Cohorts on the Basis of the Design or Analysis	Assessment of Outcome	Followup Long Enough for Outcomes to Occur	Adequacy of Followup of Cohorts	Overall Risk of Bias	Comments
van der Heide 1997[7]	Low	Low	Low	Low	Low	Unclear	Low	Non-randomized but placebo controlled

Nonpharmacologic Management of Asthma: Evidence Tables for Air Purification Studies

Table C-5. Study characteristics of air purification studies

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Pedroletti et al. 2009[13]	Airsonett Airshower filtering technique vs. Placebo Airshower: Airflow over the bed is passed through a HEPA filter and cooled. Cool, filtered air is purported to displace allergens in the breathing space during sleep.	Pet (Cat and/or Dog; unspecified)	*Type of study:* RCT, crossover design; N=28 enrolled; 22 completed both arms of crossover *Attrition:* 21% *Setting:* Home *Country:* Sweden *Followup:* Interventions were given for 10 weeks with 2 week washout in between	*Age (mean [SD]):* 18.5 (6.6) Range: 12–33 *% Male:* 45.5% *Race:* Not specified *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization:* Skin prick test positive wheal ≥3.0 mm, % participants Pet (Cat +/or Dog): 100% FeNO, ppb (SD): 32.8 (24.1) *Spirometry:* FEV1 % predicted (SD): 77.9 (16.5) Asthma medication: N (%) Daily (budesonide or fluticasone) Low: 13 (59.1) Medium: 8 (36.3) High: 1 (6.6) Dose ranges as defined by GINA Daily LABA 19 (86) Daily LTRA 7 (31.8) Mini AQLQ, mean score (SD): 5.18 (1.1)

Table C-5. Study characteristics of air purification studies (continued)

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Wright et al. 2009[14]	Mechanical heat recovery ventilation (MHRV) vs. placebo ventilation system In the placebo condition, low-level electric motors were set to 'on' but were not connected to the ventilation fans For both groups, carpets were steam-cleaned and participants were provided with new pillows, comforters, and mattress covers.	House dust mite: Der p 1	*Type of study:* RCT MHRV: 60 Placebo: 59 *Attrition:* 15% *Setting:* Home *Country:* Scotland *Followup:* 12 months	*Age (mean [SD]):* MHRV: 41.6 (9.6) Placebo: 42.3 (10.7) Min. age: 16 years *% Male:* 38.7% *Race:* Caucasian: 97.5% Asian: 2.5% *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization:* Serum HDM IgE antibody, median (IQR) MHRV: 5.7 (1.6 to 13.1) Placebo: 6.1 (2.3 to 15.2) *Asthma severity:* Asthma control score (0–6), median (IQR) MHRV: 1.57 (1.18 to 2.54) Placebo: 1.86 (1.14 to 2.71) *Baseline spirometry:* Prebronchodilator FEV_1 % predicted, mean (SD) MHRV: 83.7 (18.0) Placebo: 82.7 (17.7) Postbronchodilator FEV_1 % predicted, mean (SD) MHRV: 86.6 (18.1) Placebo: 89.5 (15.6) FVC % predicted- Prebronchodilator, mean (SD) MHRV: 93.5 (13.6) Placebo: 95.0 (15.4) *Mean duration of asthma, year,* median (IQR): MHRV: 21.0 (9.2 to 30.7) Placebo: 16.0 (9.0 to 25.0) *Comorbidity, n:* MHRV Hay fever/nasal allergy: 44 Eczema: 15 Hypertension: 5 Angina: 2 Diabetes: 3 Prior stroke: 1 Other respiratory: 0 Prior myocardial infarction: 0 Placebo Hay fever/nasal allergy: 47 Eczema: 14 Hypertension: 8 Angina: 3 Diabetes: 2 Prior stroke: 2 Other respiratory: 1 Prior myocardial infarction: 1 *Current smoker, n:* MHRV: 12 Placebo: 17

Table C-5. Study characteristics of air purification studies (continued)

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Sulser et al. 2008[15]	HEPA air cleaners vs. Placebo Air cleaners were placed in living rooms and bedrooms, with filters changed after 6 months of use	Fel d 1 and/or Can f 1	*Type of study:* RCT HEPA: 18 Placebo: 18 *Attrition:* 12% *Setting:* Home *Country:* Germany *Followup:* 12 months	*Age (median):* 12 years Range: 6–17 years *% Male:* 25% *Race:* Not specified *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization:* Mite sensitization was an exclusion criterion Serum IgE to cat, median kU/l HEPA: 33.89 Placebo: 32.40 Serum IgE to dog, median kU/l HEPA: 19.2 Placebo: 5.7 Carpet in home: 100% Exposure to Fel d 1 and/or Can f 1 >500 ng/g in home carpet dust
Francis et al. 2003[16]	HEPA air cleaners and HEPA vacuum (Active) vs. HEPA vacuum alone (Control) Air cleaners were placed in living rooms and bedrooms, and participants were instructed to vacuum carpets at least 2x/week	Fel d 1 and/or Can f 1	*Type of study:* RCT; 32 Active: 15 Control: 15 *Attrition:* 0% *Setting:* Home *Country:* U.K. *Followup:* 12 months	*Age (mean [95% CI]):* Active: 36.8 (29.3 to 44.3) Control: 41.6 (34.4 to 48.9) Age range: 18-65 yrs *% Male:* 23.3% *Race:* NR *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization:* Skin prick test positive wheal >3.0 mm Can f 1: n=29/30 Fel d 1: n=29/30 *Baseline spirometry* FEV_1 % predicted, mean (95% CI) Active: 87.3 (80.3 to 94.2) Control: 88.8 (76.8 to 100.8) PC_{20}, Geometric mean (95% CI) Active: 0.19 (0.07 to 0.56) Control: 0.23 (0.08 to 0.68) *Current smoker, n:* Active: 1 Control: 3 Atopy *Alternaria*: n=25/30 HDM: n=30/30 Grass pollen: n=30/30 Enrollment criterion: All enrolled participants kept a cat or dog in the home against medical advice

Table C-5. Study characteristics of air purification studies (continued)

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
van der Heide et al. 1999[17]	Air cleaners vs. sham air cleaners Air cleaners were placed in living rooms and bedrooms.	Fel d 1 and/or Can f 1	*Type of study:* RCT; Crossover N=20 *Attrition:* 0% *Setting:* Home *Country:* The Netherlands *Followup:* 3 months per arm; no washout	*Age (mean [SD]):* 11.7 (2.2) *% Male:* 60% *Race:* NR *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization:* Serum IgE RAST class ≥2 Can f 1: n=17/20 Fel d 1: n=18/20 *Baseline spirometry* FEV_1 % predicted, mean (SD): 90.2 (11.2) PC_{20}, Geometric mean (95% CI): 5.39 (2.64 to 11.00) Serum IgE RAST class ≥2 HDM: 20/20 Use of mattress covers: n=11/20 Smoking in home: n=7/20 Carpet in living room: n=8/20 Carpet in bedroom: n=10/20 Enrollment criterion: All enrolled participants must have kept pets to which they were sensitized in the house
van der Heide et al. 1997[18]	Air cleaners vs. Placebo air cleaners + mattress covers vs. Active air cleaners + mattress covers Air cleaners or placebo air cleaners were placed in living room and bedroom	Der p 1	*Type of study:* RCT Air cleaners: 15 Mattress covers: 15 Air cleaners + Mattress covers: 15 *Attrition:* 0% *Setting:* Home *Country:* Netherlands *Followup:* 6 months	*Age, mean* Air cleaners: 32 Mattress covers: 32 Air cleaners + Mattress covers: 33 *Age, range* Air cleaners: 18–35 Mattress covers: 19–45 Air cleaners + Mattress covers: 18–45 *% Male:* 37.8% *Race:* Not specified *Homeownership:* Not specified *Geographic environment:* Not described	*Sensitization:* Positive skin test (HEWS ≥0.7), % HDM: 24.4% HDM + pollen: 68.9% HDM + pets: 57.8% HDM + pets + pollen: 48.9% *Asthma severity:* FEV_1 % predicted, mean (range) Air cleaners: 95 (65 to 119) Mattress covers: 93 (75 to 107) Air cleaners + Mattress covers: 3.87 (78 to 124) PC_{20} histamine (mg/ml), mean (range) Air cleaners: 6.06 (0.08 to 32) Mattress covers: 8.44 (0.48 to 32) Air cleaners + Mattress covers: 7.31 (0.15 to 124) Cigarette smoke exposed in home: 33.3% Animals in home: 33.3% Floor covering in living room: 80% Floor covering in bedroom: 57.8%
Warner et al. 1993[19]	Ionizer vs. Placebo ionizer Air cleaner placed in the living room during day and bedroom at night	Der p 1	*Type of study:* RCT; Crossover N=20 *Attrition:* 0% *Setting:* Home *Country:* U.K. *Followup:* 6 weeks per arm; no washout	*Age:* Median: 9 years Range: 3–11 *% Male:* NR *Race:* NR *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization: Skin prick test positive wheal ≥3.0 mm* HDM: 100%

Table C-5. Study characteristics of air purification studies (continued)

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Mitchell et al. 1980[20]	Electrostatic precipitator (Active) vs. no air cleaner (Control) Electrostatic precipitator was run in the bedroom on high (air-flow rate 8,500 l/min) for 3-h before child's bedtime, then run on low (3,800 l/min) overnight	Der p 1 Der f 1	*Type of study:* RCT; Crossover N=10 *Attrition:* 0% *Setting:* Home *Country:* New Zealand *Followup:* 4 weeks per arm; no washout	*Age:* Range: 6.9–13.5 *% Male:* 40% *Race:* NR *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization: Skin prick test positive* HDM: 100% Asthma severity: Moderate to severe
Zwemer et al. 1973[21]	Pure-zone System (head-board mounted air filtration system) vs. Placebo system Filtered air was passed over the bed during sleeping hours	Not specified	*Type of study:* RCT; Crossover N=18 *Attrition:* 0% attrition, usable data from 66.7% *Setting:* Home *Country:* USA *Followup:* 4 weeks per arm; no washout, with follow-on open trial (40 weeks, n=4)	*Age:* Range: 6–16 *% Male:* 38.9% *Race:* NR *Homeownership:* Not specified *Geographic environment:* NR	*Sensitization:* Skin prick test positive to HDM and "other indoor allergic materials"

Can f 1=dog allergen; *Canis familiaris* allergen 1; CI=confidence interval; Der f 1=dust mite allergen, *Dermatophagoides farina* allergen 1; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; Fel d 1=cat allergen; *Felis domesticus* allergen 1; FEV_1=forced expiratory volume in one second; FEF_{25-75}=average forced expiratory flow during the middle 25–75% portion of forced vital capacity (FVC); FeNO=exhaled nitric oxide; GINA=Global Initiative for Asthma; HDM=house dust mite; HEPA=high efficiency particulate air filter; IgE=immunoglobulin E; IQR=interquartile range; LABA=long acting beta-agonists; LTRA=leukotriene receptor antagonist; MHRV=mechanical heat recovery ventilation; Mini AQLQ=Mini Asthma Quality of Life Questionnaire; Range 0–7; PEFR=peak expiratory flow rate; PC20=provocative concentration 20; assesses airway hyper-responsiveness; ppb=parts per billion; SD=standard deviation; SGRQ=St. George's Respiratory Questionnaire

Table C-6. Outcomes of air purification studies

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Pedroletti et al. 2009[13]	NR	8 exacerbations reported (Airshower: n=4; placebo: n=4; 3 exacerbations occurred in the same participant)	Mean difference in change (SEM), active – placebo **FeNO (ppb):** -6.4 (2.5); p<0.05 **Spirometry,** mean % difference: **FEV_1,** % predicted: 1.14%; n.s. **PEF**: 3.44%; n.s.	Mean difference in change (SEM), active – placebo **Mini AQLQ**: 0.54 (0.28); p<0.05	NR	NR
Wright et al. 2009[14]	Adjusted difference between groups (95% CI) **ACQ**: -0.25 (-0.57 to 0.08); n.s.	Adjusted difference between groups (95% CI) **Oral steroids**: 0.51 (0.21–1.22); n.s. **Emergency department visits**: 1.78 (0.31–10.16) **General practitioner visits:** 0.90 (0.42–1.93); n. s. **Number of hospitalizations:** MHRV: 0 Placebo: 4 p=0.12 **Rescue medicine, number of puffs:** -0.04 (-1.00 to 0.92); n.s.	Adjusted difference between groups (95% CI) **Spirometry:** **FEV_1**, % predicted: 1.32 (-2.56 to 5.19); n.s. **Morning PEFR,** l/min: 13.59 (-2.66 to 29.85); n.s. **Evening PEFR**, l/min: 24.56 (8.97 to 40.15); p=0.002; favors MHRV **Serum HDM IgE antibody:** 2.09 (-5.67 to 9.85); n.s.	Adjusted difference between groups (95% CI) **SGRQ:** -2.83 (-7.82 to 2.16); n.s.	NR	Adjusted difference between groups (95% CI) Der p 1: Bed: -0.32 (-0.84 to 0.21); n.s. Bedroom: 1.46 (-2.65 to 5.57); n.s. Living room: 0.1 (-0.8 to 0.9); n.s. Der p 2: Bed: -0.04 (-0.16 to 0.08); n.s. Bedroom: 1.07 (-1.63 to 3.76); n.s. Living room: 0.56 (-0.65 to 1.77); n.s.
Sulser et al. 2008[15]	NR	NR	**Change in FEV_1,** Before and after cold air challenge, % Data presented graphically, did not differ between groups; p=0.544	Quality of life scores did not vary between groups, data not shown	NR	Levels of allergens in bulk dust samples did not vary between groups, data presented graphically

Table C-6. Outcomes of air purification studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Francis et al. 2003[16]	NR	NR	Combined asthma outcome: PC_{20} and treatment requirement. Beneficial response defined as at least one: 2 or more doubling dose improvement in histamine reactivity and/or at least a one-step reduction in treatment medication **Improvement in combined asthma outcome:** Active: 10/15 Control: 3/15 p=0.01 **Spirometry at 12 months:** **FEV_1**, L, mean (SD) Active: 2.84 (0.87) Control: 2.59 (0.89) p=n.s. **FVC**, L, mean (SD) Active: 3.71 (0.96) Control: 3.52 (0.95) p=n.s **Mean peak flow**, L/min, mean (SD) Active: 390 (130) Control: 404 (109) p=n.s	NR	NR	Allergen levels at 12 months, geometric mean (SD) Can f 1 Airborne (mcg/m^3) Active: 2.8 (3.7) Control: 3.69 (5.4) p: n.s. Bedroom carpet (mcg/g) Active: 20.2 (15.5) Control: 134.1 (18.5) [as reported in table] p: n.s. Living room carpet (mcg/g) Active: 145.2 (3.3) Control: 317.5 (7.5) p: n.s.
van der Heide et al. 1999[17]	NR	NR	**FEV_1** was not affected by treatment (data not shown) **PC_{20},** Geometric mean increased from 5.69 to 13.01 mg/mL (p=0.003) with use of active air cleaner and returned to baseline levels in the absence of the active air cleaner (data shown graphically) **Peak flow variation:** Decreased after use of active air cleaner (p=0.045; data shown graphically)	NR	NR	Allergen levels in floor dust did not vary with treatment (data not shown)

Table C-6. Outcomes of air purification studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
van der Heide et al. 1997[18]	NR	NR	Data shown graphically (no estimate of variance on graphs), between-groups analysis not presented. **FEV_1 and Vital Capacity:** Did not differ between-groups; data not shown **PC_{20} histamine**: Improved statistically significantly in the Air filter + Mattress cover group ($p<0.05$ compared to baseline); improvements described as small and less than one doubling dose.	NR	NR	Data shown graphically (no estimate of variance on graphs), between-groups analysis not presented. For groups with mattress covers, levels of mattress dust and Der p 1 decreased over time compared to baseline.
Warner et al. 1993[19]	NR	Mean (SEM) use of bronchodilators did not differ between treatment conditions Ionizer: 0.48 (0.18) Placebo: 0.53 (0.25) p=0.275	Only 14/20 children were able to provide valid PEFR; all p_s n.s. **Morning PEFR** l/min, mean (SEM) Ionizer: 232.6 (23.4) Placebo: 231.3 (25.8) **Evening PEFR** l/min, mean (SEM) Ionizer: 239.2 (24.5) Placebo: 232.8 (26.1) ***Symptom scores;*** all p_s n.s. **Daytime wheeze** (0–3), mean (SEM) Ionizer: 0.20 (0.07) Placebo: 0.185 (0.09) **Night time wheeze** (0–3), mean (SEM) Ionizer: 0.19 (0.08) Placebo: 0.198 (0.07) **Night time cough** (0–3), mean (SEM) Ionizer: 0.43 (0.19) Placebo: 0.139 (0.04) **Day activity** (0–3), Ionizer: 0.06 (0.03) Placebo: 0.06 (0.04)	NR	NR	Airborne levels of Der p 1: levels of Der p 1 were lower during use of the active ionizer ($p<0.001$; data shown graphically)
Mitchell et al. 1980[20]	NR	NR	Mean PEFR did not vary with treatment condition (no summary statistics shown)	NR	NR	NR

Table C-6. Outcomes of air purification studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Zwemer et al. 1973[21]	NR	5/18 patients reduced **medication usage** **School absence**, n (total days): Pure-zone: 0 (0); Control: 3 (15)	NR	NR	**Asthma symptoms** were improved with use of Pure-zone (no summary statistics shown) **Uninterrupted sleep**, total nights/per condition Pure-zone: 140; Control: 45	NR

[a] Symptoms assessed by subjective symptom diary, 12-point scale with lower scores showing fewer symptoms. Validation of diary not described

[b] Symptoms assessed in similar manner as above, but total points not described. Lower scores indicate fewer symptoms. Validation of diary not described.

ACQ=Asthma control questionnaire: Range 0 to 6; Can f 1=dog allergen; *Canis familiaris* allergen I; Der f 1=dust mite allergen; *Dermatophagoides farina* allergen 1; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; Fel d 1=cat allergen; *Felis domesticus* allergen 1; FEV_1=forced expiratory volume in one second; FEF_{25-75}=average forced expiratory flow during the middle 25–75% portion of forced vital capacity (FVC); FeNO=exhaled nitric oxide; HDM=house dust mite; IgE=immunoglobulin E; MHRV=mechanical heat recovery ventilation; Mini AQLQ=Mini Asthma Quality of Life Questionnaire; Range 0–7; n.s.=not significant; PEFR=peak expiratory flow rate; Ppb=parts per billion; SD=standard deviation; SEM=standard error of the mean; SGRQ=St. George's Respiratory Questionnaire

Table C-7. Risk of bias of air purification RCTs

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Pedroletti et al. 2009[13]	Unclear	Unclear	Low	Low	High	Low	High	Insufficient description of randomization; placebo used; 22% attrition; study funded by device manufacturer
Wright et al. 2009[14]	Low	Low	Low	Low	Low	Low	Low	Placebo used; 15% attrition and ITT analysis
Sulser et al. 2008[15]	Unclear	Unclear	Low	Low	Low	Unclear	Low	Insufficient description of randomization; placebo used;12% attrition; data not shown or presented only in graph form
Francis et al. 2003[16]	Unclear	Unclear	High	Low	Low	Low	Low	Insufficient description of randomization; patients not blinded; all patients completed followup
van der Heide et al. 1999[17]	Low	Low	Low	Low	Low	High	High	Placebo used; all patients completed study; data not shown or presented only in graph form; study funded by device manufacturer
van der Heide et al. 1997[18]	Low	Unclear	Low	Low	Low	Low	High	Allocation not described; placebo used; all patients completed followup; study funded by device manufacturer
Warner et al. 1993[19]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo used; all patients completed followup
Mitchell et al. 1980[20]	Unclear	Unclear	High	High	Low	High	Low	Insufficient description of randomization; no blinding; all participants completed followup; minimal reporting of data
Zwemer et al. 1973[21]	Unclear	Unclear	Unclear	Low	High	Low	Low	Insufficient description of randomization; patients were blinded but blinding broken in some cases

ITT=intention-to-treat

Nonpharmacologic Management of Asthma: Evidence Tables for High Efficiency Particulate Air Filter (HEPA) Vacuum Studies

Table C-8. Study characteristics of HEPA vacuum studies

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Popplewell et al. 2000[22]	High-efficiency (Electrolux) vs. Standard model (Electrolux) vacuum-cleaners Participants were instructed to vacuum sofa, mattress, living room and bedroom carpet at least once a week.	Cat: Fel d 1 Dog: Can f 1 Dust mite: Der p 1	*Type of study:* RCT *Total population:* N=60 (children n=21; adults n=39) *Attrition:* 15% *Setting:* Home *Country:* U.K. *Followup:* 1 year	*Age (mean):* Mean age not reported *Age (range)*: Children (Median age: 11 years; age range 5 to 15 years); Adults (age range 22 to 63 years) *% Male:* NR *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* All patients sensitized to house dust mites; Skin prick test positive wheal ≥3.0 mm 10 of 15 cat owners were sensitized to cat; 8 participants owned a dog, none described as sensitized to dog. *Asthma severity:* Severity not reported *Comorbidity:* None reported Pet owners: 30%

Can f 1=dog allergen; *Canis familiaris* allergen I; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; Fel d 1=cat allergen; *Felis domesticus* allergen 1; RCT=randomized controlled trial; U.K.=United Kingdom

Table C-9. Outcomes of HEPA vacuum studies

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (median difference; 95% CI; p) (secondary measure)
Popplewell et al. 2000[22]	NR	NR	Data for FEV_1 PEFR, and PC_{20} presented in graphs. Only p values reported for between-group comparisons. **FEV_1:** HEV vs. SV; p=0.027 **PEFR:** HEV vs. SV; p=0.001	NR	NR	*Der p 1 (ng/m^2)*[a] *Carpet* Living room: HEV: 117; 95% CI: -2–269; p=0.089 SV: 64; 95% CI: -12–320; p=0.247 Bedroom: HEV: 10; 95% CI: -375–321; p=0.803 SV: 19; 95% CI: -278–96; p=0.58 *Sofa* HEV: 94; 95% CI: -96–842; p=0.325 SV: 64; 95% CI: -12–320; p=0.247 *Mattress* HEV: 22; 95% CI: -71–1264; p=0.179 SV: 10; 95% CI: -65–1497; p=0.377 *Fel d 1 (ng/m^2)*[a] *Carpet* Living room: HEV: -185; 95% CI: -674 to -15; p=0.046

Table C-9. Outcomes of HEPA vacuum studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (median difference; 95% CI; p) (secondary measure)
						SV: -261; 95% CI: -712 to 106; p=0.111 Bedroom: HEV: -193; 95% CI: -68 to -1848; p=0.003 SV: -180; 95% CI: -1320 to -15; p=0.061 *Sofa* HEV: -728; 95% CI: -3700 to -30; p=0.005 SV: -570; 95% CI: -1647 to 720; p=0.247 *Mattress* HEV: -491; 95% CI: -1216 to -23; p=0.013 SV: -580; 95% CI: -1702 to -23; p=0.009 *Can f 1 (ng/m^2)* [a] *Carpet* Living room: HEV: 10; 95% CI: -388 to 203; p=0.958 SV: 21; 95% CI: -118 to 2812; p=0.443 Bedroom: HEV: -78; 95% CI: -258 to 22; p=0.116 SV: -23; 95% CI: -93 to 44; p=0.511 *Sofa* HEV: -140; 95% CI: -791 to 469; p=0.542 SV: 30; 95% CI: -373 to 2035; p=0.617 *Mattress* HEV: -58; 95% CI: -726 to -28; p=0.028 SV: -14; 95% CI: -185 to 46; p=0.685

[a] All data are reported pre-post within groups, no between-groups analysis provided.

Can f 1=dog allergen; *Canis familiaris* allergen I; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; CI=confidence interval; Fel d 1=cat allergen; *Felis domesticus* allergen 1; FEV1=forced expiratory volume in one second; HEV=high-efficiency vacuum; PEFR=peak expiratory flow rate; PC20=provocative concentration 20—following methacholine challenge, the dose that produces a 20% decrease in FEV_1; assesses airway hyper-responsiveness; SV=standard vacuum

Table C-10. Risk of bias of HEPA vacuum RCTs

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Popplewell et al. 2000[22]	Unclear	Unclear	Low	Unclear	Low	Low	Low	Insufficient description of randomization; placebo used; unclear in outcome assessors were blinded; 15% attrition

Nonpharmacologic Management of Asthma: Evidence Tables for Mattress Cover Studies

Table C-11. Study characteristics of mattress cover studies

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Tsurikisawa et al. 2016[23]	Mite reduction strategies Group 1: Microfine covers encasing pillows and mattresses/futons Group 2: Vacuum with a nozzle designed to collect HDMs on mattresses/futons Group 3: Control—no devices to reduce exposure to HDM Participants in the intervention groups were also given allergen avoidance instructions which included guidance on frequency and quality of vacuuming/cleaning/laundering, removal of bedroom carpets, and controlling humidity	*Type of study:* RCT N=111; Completed n=86 Pillow/mattress covers: 50 Vacuum: 13 Control: 23 *Attrition:* 22.5% *Setting:* Home *Country:* Japan *Followup:* 1 year	*Age (mean [SD]):* Pillow/mattress covers: 48.2 (13.4) Vacuum: 53.1 (15.3) Control: 48.9 (13.7) *% Male:* Pillow/mattress covers: 34% Vacuum: 23.1% Control: 34.8% *Race:* Asian *Homeownership:* Not specified *Geographic environment:* Not specified	*Sensitization:* Der p 1-specific IgE levels (mean [SE] log in serum) Pillow/mattress covers: 2.430 (0.549) Vacuum: 2.366 (0.505) Control: 2.421 (0.612) *Asthma severity:* Step 1/2/3/4 severity of asthma (n/n/n/n per category): Pillow/mattress covers: 2/15/17/16 Vacuum: 0/4/5/4 Control: 4/6/5/8 Daily dose of (mg; converted to CFC-BDP equivalents): Pillow/mattress covers: 1092.0 (757.2) Vacuum: 1138.5 (727.5) Control: 1055.1 (672.3) FeNO, ppb, Mean (SD) Pillow/mattress covers: 32.1 (18.1) Vacuum: 36.0 (32.8) Control: 33.9 (21.2) PEF variability, mean (SD) % during 2-week baseline assessment Pillow/mattress covers: 12.4 (9.4) Vacuum: 8.2 (4.0) Control: 12.0 (9.0) Duration of asthma (y[SD]) Pillow/mattress covers: 21.1 (16.0) Vacuum: 19.5 (13.2) Control: 17.7 (16.1) *Comorbidity:* Atopic rhinitis (%): Pillow/mattress covers: 70% Vacuum: 69.2% Control: 69.6% Atopic conjunctivitis (%) Pillow/mattress covers: 52% Vacuum: 69.2% Control: 56.5% Atopic dermatitis (%) Pillow/mattress covers: 30% Vacuum: 56.5% Control: 26.1%

Table C-11. Study characteristics of mattress cover studies (continued)

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Tsurikisawa et al. 2013[24]	Microfine fiber covers (Microguard) on mattresses, futons, pillows + recommendations for routine cleaning of linens, furniture, and floors + recommendations to remove carpeting, pets, and stuffed/soft toys vs. no intervention or recommendations	*Type of study:* RCT *Total population:* 25 *Attrition:* 0% *Age cohort:* Adult *Country:* Japan *Followup:* 1 year	*Age (mean):* 47 *Age (range)*: NR *% Male:* 36% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* 44% severe; 36% moderate; 20% mild persistent *Comorbidity:* 72% atopic rhinitis; 68% atopic conjunctivitis; 36% atopic dermatitis *Carpeted bedrooms:* NR *Cat/dog in home:* 28% kept pet *Smoker in home:* NR
Glasgow et al. 2011[25]	Feather-filled pillows and feather-filled quilt + impermeable cover on mattresses vs. impermeable covers on mattress, pillows, quilts	*Type of study:* RCT *Total population:* 197 *Attrition:* 4% *Age cohort:* Mixed *Country:* Australia *Followup:* 1 year	*Age (mean):* 10 *Age (range)*: 7–14 *% Male:* 65% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR, but patients were excluded from study if allergic to cat while keeping pet *Smoker in home:* 28%
Nambu et al. 2008[26]	Impermeable pillow (Yamasei; the pillow is designed to be house dust mite-impermeable without an additional cover) vs. placebo pillow	*Type of study:* RCT *Total population:* 20 *Attrition:* 0% *Age cohort:* Child *Country:* Japan *Followup:* 1 year	*Age (mean):* median 7 vs. 6 *Age (range)*: 4–11 *% Male:* 80% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* 20% dermatitis; 15% rhinitis *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR
de Vries et al. 2007[27] and van den Bemt et al. 2007[28]	Non-polyurethane impermeable covers (Cara C'air) on mattresses, pillows, duvets vs. placebo covers	*Type of study:* RCT *Total population:* 126 *Attrition:* 17% *Age cohort:* Adult *Country:* The Netherlands *Followup:* 2 years	*Age (mean):* 42 *Age (range)*: NR; eligible patients age 16–60 *% Male:* 58% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR, but patients were excluded from study if allergic to cat or dog while keeping pet *Smoker in home:* 7% of patients were current smokers
Dharmage et al. 2006[29]	Impermeable covers on mattresses, pillows, doonas vs. placebo cotton covers	*Type of study:* RCT *Total population:* 32 *Attrition:* 6% *Age cohort:* Adult *Country:* Australia *Followup:* 6 months	*Age (mean):* 30 (intervention); 33 (control) *Age (range)*: 18–47 *% Male:* 37% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* 75% *Cat/dog in home:* 23% had cats *Smoker in home:* NR, but current smokers not eligible for enrollment
van den Bemt et al. 2004[30]	Non-polyurethane impermeable covers on mattresses, pillows, duvets vs. placebo covers	*Type of study:* RCT *Total population:* 52 *Attrition:* 0% *Age cohort:* Adult *Country:* The Netherlands *Followup:* 9 weeks	*Age (mean):* 34 *Age (range)*: NR; eligible patients age 12–60 *% Male:* 52% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR, but mean symptom score was 2.1 on a scale of 0-60 *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR, but patients were excluded from study if allergic to cat or dog while keeping pet *Smoker in home:* 21% of patients were current smokers

Table C-11. Study characteristics of mattress cover studies (continued)

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Halken et al. 2003[31]	Semi-permeable polyurethane covers (Allergy Control) on mattresses, pillows vs. placebo cotton covers	*Type of study:* RCT *Total population:* 60 *Attrition:* 17% *Age cohort:* Mixed *Country:* Denmark *Followup:* 1 year	*Age (mean):* NR *Age (range)*: NR; eligible patients age 5–15 *% Male:* NR *Race* NR: *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR, but patients were excluded from study if allergic to cat or dog while keeping pet *Smoker in home:* NR
Lee 2003[32]	Cotton bed covers boiled for 10 minutes every 2 weeks, and exposed to sunlight for more than 3 hours every 2 weeks vs. no intervention	*Type of study:* RCT *Total population:* 42 *Attrition:* NR *Age cohort:* NR *Country:* Korea *Followup:* 4 weeks	*Age (mean):* 43% <30 years *Age (range)*: NR *% Male:* 55% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 36% *Smoker in home:* NR
Luczynska et al. 2003[33]	Microfiber impermeable covers (Allerguard) on mattresses, pillows, duvets vs. placebo covers	*Type of study:* RCT *Total population:* 55 *Attrition:* 18% *Age cohort:* Adult *Country:* U.K. *Followup:* 1 year	*Age (mean):* 36 *Age (range):* NR; eligible patients age 18–54 *% Male:* 49% *Race:* NR *Geographic environment:* Urban	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR, but patients were excluded from study if allergic to cat or dog while keeping pet *Smoker in home:* NR
Woodcock et al. 2003[34]	Impermeable covers (Allergy Control Products) on mattresses, pillows, quilt covers vs. placebo polyester-cotton covers	*Type of study:* RCT *Total population:* 1,122 *Attrition:* 16% *Age cohort:* Adult *Country:* U.K. *Followup:* 1 year	*Age (mean):* 37 *Age (range)*: NR; eligible patients age 18–50 *% Male:* 36% *Race:* 98% White *Geographic environment:* NR	*Sensitization:* 65% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 55% *Smoker in home:* 23%
Rijssenbeek-Nouwens et al. 2002[5]	Impermeable covers (Cara C'air) on mattresses, pillows, bedding vs. placebo covers	*Type of study:* RCT *Total population:* 30 *Attrition:* 21% *Age cohort:* Adult (but 2 patients were 11 years old) *Country:* The Netherlands *Followup:* 1 year	*Age (mean):* 29 *Age (range)*: 11–51 *% Male:* 57% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* All patients moderate or severe *Comorbidity:* 67% rhinitis *Carpeted bedrooms:* Patients with carpeted bedrooms were excluded from the study *Cat/dog in home:* NR, but patients were excluded from study if allergic to cat or dog while keeping pet *Smoker in home:* Smokers were excluded from the study
Sheikh et al. 2002[35]	Impermeable covers (Allerayde) on mattresses, pillows, duvets vs. placebo covers	*Type of study:* RCT *Total population:* 47 *Attrition:* 8% *Age cohort:* Mixed *Country:* U.K. *Followup:* 1 year	*Age (mean):* 11 *Age (range)*: NR; eligible patients age 5–14 *% Male:* 62% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* Pet owners were excluded from the study *Smoker in home:* NR

Table C-11. Study characteristics of mattress cover studies (continued)

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Frederick et al. 1997[36]	Impermeable covers (Intervent) on mattresses, pillows, duvets vs. placebo polycotton covers	*Type of study:* Crossover RCT: intervention for 3 months, then 1 month wash-out period, then groups switched for 3 months *Attrition:* NR *Total population:* 31 *Age cohort:* Mixed *Country:* U.K. *Followup:* 1 year	*Age (mean):* 9 *Age (range)*: 5–15 *% Male:* 65% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 23% *Smoker in home:* NR
Burr et al. 1980[37]	Impermeable plastic covers on mattresses + provision of new bedding and pillow vs. no intervention	*Type of study:* Crossover RCT: intervention for 1 month, then groups switched for 1 month *Attrition:* 0% *Total population:* 21 *Age cohort:* Mixed *Country:* U.K. *Followup:* NR	*Age (mean):* NR *Age (range)*: NR *% Male:* NR *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR
Burr et al. 1976[38]	Impermeable plastic covers on mattresses vs. vacuuming of upholstered furniture + recommendation to vacuum carpet regularly	*Type of study:* Crossover RCT: intervention for 6 weeks, then groups switched for 6 weeks *Total population:* 32 *Attrition:* NR% *Age cohort:* Adult *Country:* U.K. *Followup:* NR	*Age (mean):* 33 *Age (range)*: NR *% Male:* 56% *Race:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR

CFC-BDP=chlorofluorocarbon-propelled beclomethasone dipropionate; Der f 1=dust mite allergen; *Dermatophagoides farina* allergen 1; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; FeNO=exhaled nitric oxide; HDM=house dust mite; ICS=inhaled corticosteroid; IgE= immunoglobulin E; NR=not reported; PEF=peak exploratory flow; RCT=randomized controlled trial; SD=standard deviation; SE=standard error; U.K.=United Kingdom

Table C-12. Outcomes of mattress cover studies

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Tsurikisawa et al. 2016[23]	NR	NR	**FeNO,** ppb, Mean (SD) Pillow/mattress covers: 36.3 (23.3) Vacuum: 29.1 (22.3) Control: 35.8 (19.4) All p_s n.s. **PEF variability**, mean (SD) % during 2-week final assessment Pillow/mattress covers: 10.3 (6.7) Vacuum: 10.7 (6.3) Control: 14.1 (10.3) All p_s n.s.	NR	NR	log Der 1 (log ng/m^2) mean (SD): Tape collection from mattress/futon bedding Pillow/mattress covers: 1.281 (0.830) Vacuum: 1.179 (1.072) Control: 1.262 (0.946) All between-group p_s n.s. log Der 1 (log ng/m^2) mean (SD): Tape collection in petri dish 100 cm above bedroom floor Pillow/mattress covers: 2.039 (0.749) Vacuum: 1.872 (1.365) Control: 2.031 (0.838) All between-group p_s n.s.
Tsurikisawa et al. 2013[24]	NR	NR	**Peak flow** Minimum % PF increased significantly in intervention group: p<0.01 (data reported in figure)	NR	**Symptom score** (cough, wheeze, sneezing, sputum, dyspnea, use of short-acting beta stimulants, and ED visits) Significant decrease in symptoms, intervention vs. control (p<0.01, data reported in figure)	**Der p 1 and Der f 1** Significantly lower allergen levels on mattresses/futons in intervention group vs. control group: p<0.01 (data reported in figure)
Glasgow et al. 2011[25]	NR	NR	NR	**Juniper Paediatric Quality of Life Questionnaire** No differences between groups in difference effect Overall score (CI): 0.04 (-0.27–0.35, p=0.80) Activity: 0.17 (-0.23–0.57, p=0.41) Symptoms: 0.04 (-0.28–0.36) Emotional function: -0.01 (-0.33–0.31, p=0.97)	**Frequent wheeze** (≥4 times) No difference between groups OR: 1.51 (0.83–2.76, p=0.17) **Speech-limiting wheeze** No difference between groups OR: 0.70 (0.32–1.48, p=0.35) **Sleep disturbance caused by wheeze** No difference between groups OR: 1.17 (0.64–2.13, p=0.61)	**Der p 1** No significant difference between groups Median (IQR), pg/m^3: 16.0 (1.0–54.1) vs. 28.0 (1.0–66.8), p=0.3

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Nambu et al. 2008[26]	NR	**Asthma attacks** No difference between groups (data reported in figure)	NR	NR	NR	**Eosinophil levels** No difference between groups in IgE levels for house dust mite (data reported in figure)
de Vries et al. 2007[27] van den Bemt et al. 2007[28]	NR	**Inhaled corticosteroids** No significant difference between groups for total ICS doses over study period Estimated total difference (CI), intervention vs. control: -830.8 mcg (-1646.2–92.3), p=0.08	**Morning peak flow** No difference between groups (p=0.52, data not shown) **Peak flow variability** No difference between groups (p=0.36, data not shown)	**Mini Asthma Quality of Life Questionnaire** No difference within and between groups Incremental change, intervention vs. control: -0.03, p=0.82	**Asthma symptom score** (6-point scale) No difference within or between groups Baseline mean score: 1.13 vs. 1.05 Followup: 1.03 vs. 1.71 (p=027) **Cough** No difference between groups (p=0.41, data not shown) **Wheeze** No difference between groups (p=0.77, data not shown) **Dyspnea** No difference between groups (p=0.46, data not shown)	**Der p 1 concentration** Significantly lower allergen levels in intervention group vs. control Baseline, ng/g: 863 vs. 806 Followup: 115 vs. 895 (p<0.01) **Der p 1 density** Significantly lower allergen density in intervention group vs. control Baseline, ng/m^2: 52 vs. 61 Followup: 10 vs. 115 (p<0.01)
Dharmage et al. 2006[29]	NR	**Relief medication** No difference within or between groups **Mean change in puffs per day (CI):** 0.36 (-0.14–0.85) vs. 0.20 (-0.02–0.43)	**Peak flow variability** No difference within or between groups Mean change (CI): 1.95 (-0.05–3.9) vs. 0.50 (-1.50–2.50)	**Quality of life** (measurement scale not described) Significant improvement within groups but not between groups (p<0.05; data reported in figure)	**Daytime symptom score** (wheeze, cough, sleep disturbance, activity restriction) No difference within or between groups Mean change (CI): 0.02 (-0.03–0.07) vs. 0.04 (-0.02–0.10) **Nighttime symptom score** No difference within or between groups Mean change (CI): 0.20 (-0.08–0.49) vs. 0.14 (-0.17–0.45)	**Der p 1** Significant difference between groups Baseline, mcg/g: 19.2 vs. 18.9 Followup: 7.3 vs. 21.2 (p<0.05)
van den Bemt et al. 2004[30]	NR	NR	**Peak flow** Significantly improved between groups, p=0.01 (data reported in figure), however repeated measurement analysis showed no significant change over time	NR	NR	**Der p 1** Significant difference between groups, geometric mean, mcg/m^2 Baseline (CI): 0.96 (0.40–2.31) vs. 0.70 (0.32-1.53) Followup: 0.04 (0.02–0.11) vs. 0.46 (0.18–1.17) (p<0.05)

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Halken et al. 2003[31]	NR	**Beta-agonist doses per 2 weeks** Change from baseline: reduction of 8 vs. 7 (p=n.s.) **Systemic steroids** No patients required use **ICS Dose** % patients with dose reduced ≥50%: 73% vs. 24% (p<0.01) Change in mean ICS dose: -181 mcg vs. -39 mcg (p<0.01)	**Peak flow** Significant increase in both groups over baseline (p<0.01) No difference between groups (data not shown) **FEV_1** Significant increase in both groups over baseline (p<0.01) No difference between groups (data not shown)	NR	**Daytime symptom score** No difference within or between groups Baseline mean: 1.62 vs. 3.33 Followup mean: 1.73 vs. 2.57 **Nighttime symptom score** No difference within or between groups Baseline mean: 0.46 vs. 1.48 Followup mean: 1.08 vs. 1.90	**Total house dust mite (Der p 1, Der f 1, Der m 1) geometric mean**, ng/g dust Baseline: 15,604 vs. 8,791 Followup: 1,456 vs. 4,311 (p=0.03)

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Lee 2003[32]	NR	**Asthma attack** No difference within or between groups Baseline mean (SD): 0.32 (1.49) vs. 0.95 (4.25) Followup: 0.14 (0.47) vs. 0.75 (3.13)	**Morning peak flow** No difference within or between groups Baseline mean (SD): 86.45 (14.89) vs. 92.45 (13.92) Followup: 88.60 (13.66) vs. 89.43 (17.33), p=0.10, intervention vs. control **Evening peak flow** No difference within or between groups Baseline mean (SD): 88.09 (13.88) vs. 93.50 (12.42) Followup: 90.27 (13.46) vs. 91.10 (17.28), p=0.095 groups Baseline mean (SD): 20.81 (39.09) vs. 16.35 (28.27) Followup: 10.63 (24.94) vs. 14.65 (26.94)	NR	**Cough** No difference within or between groups Baseline mean (SD): 41.14 (81.68) vs. 38.95 (48.29) Followup: 22.27 (50.05) vs. 36.85 (63.44) **Wheeze** Significant improvement within intervention but not between groups Baseline mean (SD): 2.23 (4.87) vs. 3.40 (11.48) Followup: 0.27 (1.08) vs. 2.00 (6.70) **Dyspnea** Significant improvement between groups Baseline mean (SD): 2.55 (5.19) vs. 0.85 (3.57) Followup: 1.18 (2.79) vs. 2.20 (4.69) **Sputum** Significant improvement within intervention but not between **Sleep disturbance** Significant increase in intervention group Baseline mean (SD): 1.86 (7.43) vs. 1.15 (4.69) Followup: 3.09 (14.28) vs. 2.05 (6.49)	**Der p 1** Significant increase in allergen in intervention group Baseline (SD), ng/g of dust: 220.8 (318.5) versus1687.4 (4741.1) Followup: 330.5 (627.8) vs. 1484.9 (4599.6), p=0.02 **Der f 1** Significant reduction in allergen in intervention group Baseline (SD), ng/g of dust: 19877.7 (14726.4) vs. 18314.1 (17358.8) Followup: 14054.6 (9949.6) vs. 16394.5 (19432.4), p<0.01

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Luczynska et al. 2003[33]	NR	**Asthma attacks** No difference between or within groups (data not reported) **Medication use** No difference between or within groups (data nor reported)	**Peak flow** No difference within or between groups Baseline mean (CI): 325 (295–382) vs. 347 (322–372) Followup: 367 (289–445) vs. 388 (350–428)	**Marks Asthma Quality of Life Questionnaire** No difference within or between groups Mean decrease in square root of score (CI): 0.44 (-0.25–1.14) vs. 0.69 (-0.04–1.42)	**Chest tightness** No difference within or between groups Baseline days (CI): 7.17 (5.26–9.08) vs. 6.05 (4.09–8.01) Followup: 4.88 (2.32–7.44) vs. 5.93 (2.98–8.88)	**Der p 1** Significant decrease in both groups, no difference between groups Baseline geometric mean (CI): 18.90 (9.41–37.97) vs. 25.05 (11.56–54.59) Followup: 0.38 (0.13–1.18) vs. 2.31 (1.11–4.82)
Woodcock et al. 2003[34]	NR	**Exacerbations** (1 hospital visit or 1 course of oral corticosteroids in previous 6 months) No difference between groups 10.3% vs. 12.0% RR (CI): 0.85 (0.60–1.21), p=0.38 **Daytime beta-agonist** Reduction in both groups but not between groups Baseline, mean number of puffs: 2.91 vs. 2.73 Followup: 2.24 vs. 2.26 Adjusted difference (CI): -0.15 (-0.32–0.02) p=0.08 **Nighttime beta-**	**Peak flow** Significant improvement in both groups but not between groups Baseline, mean liters/minute: 410.7 vs. 417.8 Followup: 419.1 vs. 427.4 Adjusted difference (CI), liters/minute: -1.6 (-5.9–2.7), p=0.46	**St. George's Respiratory Questionnaire** Proportion of patients reporting that their quality of life had improved No difference between groups 71.3% vs. 71.7% RR (CI): 1.00 (0.92–1.08), p=0.90)	**Daytime symptom score** (components not described) No difference within or between groups Baseline mean: 1.32 vs. 1.33 Followup: 1.07 vs. 1.09 Adjusted difference (CI): -0.02 (-0.10–0.06), p=0.65 **Nighttime symptom score** (components not described) No difference within or between groups Baseline mean: 0.92 vs. 0.94 Followup: 0.76 vs. 0.76 Adjusted difference (CI): 0.01 (-0.06–0.08), p=0.77	**House dust mite allergens** (not specified) Significant reduction compared with control group Exposure to allergen, geometric mean, µg/g: 0.58 vs. 1.71, p=0.01

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
		agonist Reduction in both groups but not between groups Baseline, mean number of puffs: 1.36 vs. 1.47 Followup: 1.17 vs. 1.27 Adjusted difference (CI): -0.02 (-0.13–0.10) p=0.78 **Missed days of work** Significantly fewer days in intervention group Mean days per previous month: 0.11 vs. 0.25 Unadjusted difference (CI): -0.15 (-0.29 -- -0.02				

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Rijssenbeek-Nouwens et al. 2002[5]	NR	**Rescue medication** No significant change in either group (data not shown)	**Morning peak flow** No significant difference within or between groups Baseline median (range): 426 (226–727) vs. 432 (292–581) Followup: 440 (246–740) vs. 416 (240–600) **Evening peak flow** No significant difference within or between groups Baseline median (range): 422 (225–683) vs. 434 (228–625) Followup: 425 (247–748) vs. 406 (236–700)	**Quality of Life for Respiratory Illness Questionnaire** No difference between groups Significant improvement within each group (data not shown)	**Pulmonary symptoms score** (cough, wheeze, dyspnea, expectoration) No difference within or between groups Baseline median (range): 2.04 (0.0–8.25) vs. 1.27 (0.0–8.35) Followup: 1.46 (0.0–7.07) vs. 0.36 (0.0–10.92) **Nasal symptoms score** (nasal blockage, sneezing, itching, rhinorrhea) Significant improvement within intervention group, no difference between groups Baseline median (range): 1.67 (0.0–6.57) vs. 1.93 (0.0–11.16) Followup: 0.79 (0.0–5.21) vs. 1.43 (0.0–10.92)	**Der p 1** Significant decrease within intervention group, and between groups Baseline, mcg/g: 26.19 vs. 23.28 Followup: 2.79 vs. 25.11
Sheikh et al. 2002[35]	NR	**Systemic steroid dose** No differences 2 in each group **Hospitalizations** None in either group **ICS dose** No difference between groups Mean change, 28-day dose, mcg (SD): -1815.91 (3861.45) vs. -1039.00 (1881.15), p=0.41	**Peak flow** No difference between groups Mean change liters/min (SD): 16.38 (25.62) vs. 13.68 (43.14), p=0.81	NR	**Asthma symptoms score** (cough, wheeze, shortness of breath, chest tightness) No difference between groups Mean change (SD): -3.40 (29.50) vs. -18.10 (27.80), p=0.12 **Nighttime waking** No difference between groups Mean change, episodes per month (SD): -0.64 (3.00) vs. -0.94 (2.30), p=0.43	NR

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Frederick et al. 1997[36]	NR	**Beta-agonist use** No difference within groups Baseline median (range), µg: 120 (0.0–986) vs. 60 (0.0–542) Followup: 80 (0–312) vs. 40 (0–372)	**Morning peak flow** No difference within groups (between-group comparisons not conducted) Baseline median (range), L/min[1]: 262 (132–389) vs. 269 (141–390) Followup: 257 (177–391) vs. 282 (155–428) **Evening peak flow** No difference within groups (between-group comparisons not conducted) Baseline median (range), L/min[1]: 265 (142–402) vs. 274 (160–418) Followup: 258 (174–407) vs. 307 (167–432) **Forced expiratory volume** No difference within intervention group Baseline median (range): 86% (43–123) Followup: 85% (53–114)	NR	**Asthma score for previous night** No difference within groups (between-group comparisons not conducted) Baseline median (range): 0.2 (0.0–1.9) vs. 0.09 (0.0–2.5) Followup: 0.1 (0.0–0.8) vs. 0.09 (0.0–1.7) **Daytime wheeze score** No difference within groups (between-group comparisons not conducted) Baseline median (range): 0.4 (0.0–1.2) vs. 0.3 (0.0–2.1) Followup: 0.3 (0.0–1.1) vs. 0.2 (0.0–1.1) **Exercise tolerance score** No difference within groups (between-group comparisons not conducted) Baseline median (range): 0.4 (0.0–1.6) vs. 0.2 (0.0–2.1) Followup: 0.2 (0.0–1.1) vs. 0.2 (0.0–1.2)	**Der p 1** Significant decrease in allergen concentration on mattresses, pillows, and duvets, for intervention compared with control group ($p<0.01$)
Burr et al. 1980[37]	NR	NR	**Morning peak flow** No difference within groups Mean coefficient of variation (SE): 11.6 (1.4) vs. 14.6 (1.6) **Evening peak flow** No difference within groups Mean coefficient of variation (SE): 12.2 (1.4) vs. 12.9 (1.3)	NR	NR	NR

Table C-12. Outcomes of mattress cover studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Burr et al. 1976[38]	NR	NR	**Peak flow** No difference within groups Mean (SE), liters/min: 335 (19.6) vs. 329 (20.8)	NR	NR	NR

CI=95% confidence interval; Der f 1=*dermatophagoides farina* allergen 1; Der p 1: *dermatophagoides pteronyssinus* allergen 1; ED=emergency department; FEV_1=forced expiratory volume in 1 second; IQR=interquartile range; mcg/g=micrograms per gram; NR=not reported; n.s.=not significant; OR=odds ratio; PACQLQ=pediatric asthma caregivers asthma quality of life questionnaire; PF=peak expiratory flow; PFV=peak flow variability; pg/m^3=phosphoglucomutase 3; RCT=randomized controlled trial; RR=relative risk; SD=standard deviation; SE=standard error

Table C-13. Risk of bias of mattress cover studies

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Tsurikisawa et al. 2016[23]	Unclear	Unclear	High	Unclear	High	Low	Low	Insufficient description of randomization; patients not blinded; unclear if outcome assessors were blinded; 23% attrition; no ITT analysis
Tsurikisawa et al. 2013[24]	Unclear	Unclear	High	High	Low	Low	Low	Insufficient description of randomization; no blinding; all patients completed study
Glasgow et al. 2011[25]	Low	Low	Low	Low	Low	Low	Low	Placebo; patients and assessors blinded; low attrition; ITT analysis; pre-specified outcomes reported
Nambu et al. 2008[26]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo; patients and assessors blinded; all patients completed study
de Vries et al. 2007[27]	Low	Low	Low	Low	Unclear	Low	Low	Placebo; patients blinded and most outcomes patient-reported; moderate attrition rate of 17% but ITT analysis used; pre-specified outcomes reported; study funded in part by pharmaceutical manufacturers
Dharmage et al. 2006[29]	Low	Low	Low	Low	Low	Low	Low	Placebo; participants and assessors blinded; low attrition; pre-specified outcomes reported
van den Bemt et al. 2004[30]	Unclear	Unclear	Low	Low	Low	High	Low	Insufficient description of randomization; placebo; patients blinded and most outcomes patient-reported; ITT analysis used; did not report followup symptom score because baseline scores were very low
Halken et al. 2003[31]	Low	Low	Low	Low	High	Low	Low	Placebo; participants and assessors blinded; 17% attrition
Lee 2003[32]	Unclear	Unclear	High	High	High	High	Low	Insufficient description of randomization; no placebo; no blinding; 30% attrition

Table C-13. Risk of bias of mattress cover studies (continued)

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Luczynska et al. 2003[33]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo; patients blinded and most outcomes patient-reported; ITT analysis found similar results; pre-specified outcomes reported
Woodcock et al. 2003[34]	Low	Low	Low	Low	Low	Low	Low	Placebo; participants and assessors blinded; 16% attrition;
Rijssenbeek-Nouwens et al. 2002[5]	Unclear	Unclear	Low	Low	High	Low	Low	Insufficient description of randomization; placebo; patients blinded and most outcomes patient-reported; 21% attrition with no apparent ITT analysis; pre-specified outcomes reported
Sheikh et al. 2002[35]	Low	Low	Low	Low	Low	Low	Low	Placebo; participants and assessors blinded; low attrition; pre-specified outcomes reported
Frederick et al. 1997[36]	Unclear	Unclear	Low	High	Unclear	Low	High	Insufficient description of randomization; patients only blinded; attrition not described; pre-specified outcomes reported; 3/5 authors funded or employed by relevant industry
Burr et al. 1980[37]	Unclear	Unclear	High	High	Low	High	Low	Insufficient description of randomization; no blinding; no placebo; attrition not described, very few outcomes reported
Burr et al. 1976[38]	Unclear	Unclear	High	High	Unclear	High	Low	Insufficient description of randomization; no blinding; no placebo; attrition not described, very few outcomes reported

ITT=intention to treat

Nonpharmacologic Management of Asthma: Evidence Tables for Pest Control Studies

Table C-14. Study characteristics of pest control studies

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Levy et al. 2006[39]	Intervention consisted of one-time deep cleaning, including HEPA vacuuming, setting traps, sealing rodent access points, replacement of mattresses, education about kitchen hygiene and food storage, reducing clutter, and communicating with housing authority and pest contractors	Bla g 1 Bla g 2 Can f 1 Der f 1 Der p 1 MUP Alternaria	*Type of study:* Pre-post: N=78 ever enrolled; Competed: n=50 children (41 households) *Attrition:* 35.9% *Setting:* Home *Country:* U.S. *Followup:* up to 66 weeks	*Age (mean):* Intervention: 7.5 Control: 7.6 *Age (range)*: 4–17 *% Male:* Intervention: 58% Control: 67.1% *Race:* Hispanic: 70% African American: 28% Caucasian: 2% *Homeownership:* Public housing *Geographic environment:* Urban	*Sensitization:* Skin prick test positive wheal Any allergen: 77% Cockroach allergen: 58% HDM: 60% *Asthma severity:* Baseline symptoms reported graphically *Comorbidity:* None reported

Bla g 1, Bla g 2=cockroach allergen; *Blatella germanica* allergen I / 2; Can f 1=dog allergen; *Canis familiaris* allergen I; Der f 1=*dermatophagoides farina* allergen 1; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; Fel d 1=cat allergen; *Felis domesticus* allergen 1; HDM=house dust mite; HEPA=high efficiency particulate air filter; MUP=mouse urinary protein; Mus m 1=mouse allergen; *Mus musculus* allergen 1; U.S.=United States

Table C-15. Outcomes of pest control studies

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Levy et al. 2006[39]	NR	No changes (data not shown; rates described as low)	NR	**Asthma related quality of life** (7-point scale): Clinically significant mean improvement of 1.32 points (no variance reported)	**Respiratory symptoms,** mean score (no variance reported) Pre-intervention: 2.6 Post-intervention: 1.5 p=0.0002	**Percentage of allergen decrease** (baseline-final measurement); no statistical analysis presented. Bla g 1 (U/g) Air: 57% Bed: 58% Kitchen: 61% Bla g 2 (U/g) Air: 62% Bed: 56% Kitchen: 65% Can f 1 (mcg/g) Air: 42% Bed: 37% Der f 1 (mcg/g) Air: 43% Bed: 61% Der p 1 (mcg/g) Air: 49% Bed: 52%

Table C-15. Outcomes of pest control studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
						Fel d 1 (mcg/g) Air: 49% Bed: 62% MUP (mcg/g) Air: 51% Bed: 46% Kitchen: 42% *Alternaria* (mcg/g) Air: 49% Bed: 38%

Bla g 1, Bla g 2=cockroach allergen; *Blatella germanica* allergen I / 2; Can f 1=dog allergen; *Canis familiaris* allergen I; Der f 1=dust mite allergen; *Dermatophagoides farina* allergen 1; Der p 1=dust mite allergen; *Dermatophagoides pteronyssinus* allergen 1; Fel d 1=cat allergen; *Felis domesticus* allergen 1; MUP=mouse urinary protein; U/g=units per gram

Table C-16. Risk of bias of pest control non-controlled study

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Levy et al. 2006[39]	Medium	Low	Low	Low	Medium	Low	Low	Non-randomized pre-post study; all patients were Hispanic or African-American; minimum followup of 3 months

Nonpharmacologic Management of Asthma: Evidence Tables for Other/Miscellaneous Intervention Studies

Table C-17. Study characteristics of other/miscellaneous intervention studies

Study	Intervention	Allergen(s)	Study Design	Demographic Factors	Clinical Factors
Barnes et al. 2008[40]	Cleaning: Cleaning protocol not described. Group 1: Regular products containing household bleach; Group 2: Regular products as above plus three additional products with dilute 0.09% hypochlorite; Group 3: Control, no cleaning products given Cleaning products from Clorox Corp: Ultra Clorox Bleach, Clorox Clean Up, Clorox Disinfecting Wipes, Ready Mop, Clorox Toilet Bowl Cleaner, Clorox Disinfecting Spray, and Clorox Toilet Bowl Automatic Cleaning Tablets. Trial funded by Clorox Corp.	Bacteria, fungi, and protein allergens	*Type of study:* RCT N=97 families *Attrition:* 6.2% *Setting:* Home *Country:* U.S. *Followup:* 8 weeks Study included arm of participants with no diagnosis of asthma, data not reported here	*Age:* NR, enrollment required "at least one person between 2 and 17 years" in the household *% Male:* NR *Race:* NR *Homeownership:* Not specified *Geographic environment:* Urban core: 40% Suburban: 55% Rural: 5%	Sensitization: NR Asthma severity: NR; participants with asthma recruited from asthma clinic (single site) Quality of life: Baseline scores for quality of life not described. Wall-to-wall carpet in home: 89% Pets in home (at least one): Cats: 18% Dogs: 58%

NR=not reported; RCT=randomized controlled trial; U.S.=United States

Table C-18. Outcomes of other/miscellaneous intervention studies

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)	Other
Barnes et al. 2008[40]	NR	**Controller meds in P.M.** Product: 3.73 (6.06) Control: 4.17 (6.57) p=0.38 **Controller meds in A.M.** Product: 4.03 (6.06) Control: 5.12 (7.21) p=0.04	NR	Data shown graphically (no estimate of variance on graphs), between-groups analysis not presented. Quality of life scores improved for all groups relative to baseline (all p_s <0.05)	Data reported for both groups using cleaning products vs. control. Data for experimental intervention not reported separately. Any cleaning product Product (n=283) Control (n=276) Scores derived from 7-point Likert scale, mean (SD) **Wheeze in P.M.** Product: 1.70 (2.27) Control: 2.47 (3.42) p=0.001 **Wheeze in A.M.** Product: 1.67 (2.59) Control: 2.10 (2.90) p=0.05 **Cough in A.M.** Product: 3.47 (4.53) Control: 4.14 (5.13) p=0.08 **Cough in P.M.** Product: 3.44 (4.39) Control: 2.47 (3.42) p=0.004 **Breathing trouble in P.M.** Product: 2.18 (3.31) Control: 4.61 (5.54) p=0.001 **Breathing trouble in A.M.** Product: 2.02 (2.95) Control: 2.86 (3.85) p=0.02	Levels of all dust allergens did not vary statistically as a function of treatment group. Comparative data of allergens not shown for cleaning vs. control in asthma participants alone.	Data reported here for population with asthma only. Main outcome of quality of life was improved in all groups; authors note possibility of placebo effect due to keeping diaries in control group. Because asthma symptoms are not reported separately for each type of cleaning product, it is not possible to evaluate the primary hypothesis that products containing sodium hypochlorate affect allergen levels.

SD=standard deviation

Table C-19. Risk of bias of other/miscellaneous RCTs

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Barnes et al. 2008[40]	Unclear	Unclear	High	High	Low	High	High	Insufficient description of randomization; no blinding; 6% attrition; data not reported for primary intervention group separately; study funded by manufacturer of cleaning supplies

Nonpharmacologic Management of Asthma: Evidence Tables for Multicomponent Studies

Table C-20. Study characteristics of multicomponent studies

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
DiMango et al. 2016[41]	*Intervention:* - Impermeable covers (brand NR) on mattresses - Vacuum (Electrolux; not specified if HEPA-filtered) - HEPA air purifier (Orek) - Mops (Swiffer WetJet) - Cleaning products (not specified) - Education and instruction from 'intervention counselors' *Control:* Education from 'intervention counselors'	Der p or f Bla g Fel d Can f Mus m Mold	*Type of study:* RCT *Total population:* 247 *Attrition:* 16% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 40 weeks	*Age (mean):* NR; 45% age 6–17, 55% age 18–69 *Age (range)*: 6–69 *% Male:* 45% *Race:* 56% Hispanic; 37% Black; 3% White *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* All patients sensitized to at least 1 allergen *Asthma severity:* 67% step 4–6; 33% step 1–3 *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 31%
Shani et al. 2015[42]	*Intervention:* - Hypoallergenic covers (brand NR) on mattresses, pillows - Cockroach and mouse bait - Cleaning supplies - Education and instruction from community health workers *Control:* This is a pre-post study	Der p or f Bla g Fel d Can f Mus m	*Type of study:* Pre-post *Total population:* 80 *Attrition:* 39% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 6 months	*Age (mean):* 7 *Age (range)*: NR; eligible patients age 2-17 *% Male:* 54% *Race:* "most children identified as African American" *Homeownership:* "most of the families were renters" *Geographic environment:* NR	*Sensitization:* NR *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 44%
Breysse et al. 2014[43]	*Intervention:* - Weatherization-related interventions, including, as needed: replacing carpet with laminate, vinyl, hardwood, or low-volatile-organic-compound carpet; insulation of home, pipes, ductwork; plumbing repair; door replacement or weather-stripping; replacing bathroom fans and/or installing fan timers; replacement of range and dryer hoods; and additional interventions - Hypoallergenic covers (brand NR) on mattresses, pillows - HEPA vacuums - Cleaning supplies - Education and instruction from community health workers *Control (matched historical comparison group):* - Hypoallergenic covers (brand NR) on mattresses, pillows - HEPA vacuums - Cleaning supplies - Education and instruction from community health workers	Der p or f Bla g Fel d Can f Mus m Mold	*Type of study:* Quasi-experimental *Total population:* 102 *Attrition:* 24% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* NR *Age (range)*: NR; eligible patients age 3-17 *% Male:* 60% *Race:* 46% Hispanic; 21% Vietnamese; 15% African American; 9% Asian; 8% White *Homeownership:* 0% *Geographic environment:* Urban	*Sensitization:* NR *Asthma severity:* 53% "not well controlled"; 47% "very poorly controlled" *Comorbidity:* NR *Carpeted bedrooms*: NR *Cat/dog in home*: 20% *Smoker in home*: 3%

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Turcotte et al. 2014[44]	*Intervention:* - HEPA vacuums - Integrated pest management - Professional cleaning - Cleaning supplies - Education and instruction from community health workers *Control:* This is a pre-post study	Der p or f Bla g Fel d Can f Mus m	*Type of study:* Pre-post *Total population:* 170 *Attrition:* 31% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 6 *Age (range)*: NR; eligible patients age 15 or younger *% Male:* 60% *Race:* 53% Hispanic; 15% Asian; 12% White; 5% Black *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* NR *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 16%
Sweet et al. 2013[45]	*Intervention:* - Hypoallergenic covers (brand NR) on mattresses, pillows, box springs - HEPA vacuum - Integrated pest control - Cleaning supplies - Mold removal - Dehumidifier and ventilation if necessary - Education and instruction from community health workers *Control:* This is a pre-post study	Der p or f Bla g Fel d Can f Mus m Mold	*Type of study:* Pre-post *Total population:* 115 *Attrition:* NR *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 6 months	*Age (mean):* 7 *Age (range)*: 1-18 *% Male:* 58% *Race:* 72% African American; 17% White; 5% Hispanic *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* NR *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home*: NR *Smoker in home:* NR
El-Ghitany et al. 2012[46]	*Intervention:* - Hypoallergenic covers on mattresses, pillows - Carpet removal or vacuuming more than 1 time/week - Ventilation - Removal of pets *Control:* No intervention	Der p	*Type of study:* RCT *Total population:* 160 *Attrition:* 0% *Age cohort:* Mixed *Setting:* Home *Country:* Egypt *Followup:* 16 weeks There was an initial 8 month cross-sectional study prior to conducting the RCT	*Age (mean):* 8 Age (range): 5–12 *% Male:* 56% *Race:* NR *Homeownership:* NR *Geographic environment:* Urban: 40%	*Sensitization:* 100% Der p 1 *Asthma severity:* 43% uncontrolled *Carpeted bedrooms:* NR *Cat/dog in home:* 46% *Smoker in home:* 30%

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Takaro et al. 2011[47]	*Intervention:* - Occupancy in "Breathe-Easy-Home," features include exterior with moisture proofing, interior finishes and flooring that minimizes dust, and heat-exchange ventilation system with filtration - Hypoallergenic covers (brand NR) on mattresses, pillows - HEPA vacuums - Cleaning supplies - Education and instruction from community health workers *Control (matched historical comparison group):* - Hypoallergenic covers (brand NR) on mattresses, pillows - HEPA vacuums - Cleaning supplies - Education and instruction from community health workers	Der p or f Bla g Fel d Can f Mus m Mold	*Type of study:* Quasi-experimental *Total population:* 102 *Attrition:* NR *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):*NR *Age (range)*: NR; eligible patients age 3–17 *% Male:* 69% *Race:* 35% Hispanic; 22% Black; 17% Vietnamese; 13% Asian; 6% White *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* NR *Asthma severity:* 19% severe; 32% moderate persistent; 36% mild persistent; 15% intermittent *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 16% *Smoker in home:* 6%
Bryant-Stephens et al. 2009[48]	*Intervention:* - Hypoallergenic covers (brand NR) on mattresses, pillows - Cockroach and mouse bait - Tiles to replace carpet - Cleaning supplies - Education and instruction from community health workers *Control:* This is a crossover study	Der p or f Bla g Fel d Can f Mus m	*Type of study:* Crossover RCT *Total population:* 264 *Attrition:* 23% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 6 months	*Age (mean):* 6 *Age (range)*: NR; eligible patients age 2–16 *% Male:* 66% *Race:* 94% Black *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* NR *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* 53% *Cat/dog in home:* 41% *Smoker in home:* 50%
Krieger et al. 2009[49]	*Intervention:* - Impermeable covers (brand NR) on mattresses, pillows - Low emission vacuum (brand NR) - Cleaning kits - Commercial-quality door mats - Education and instruction from community health workers, including up to 5 home visits *Control:* - Impermeable covers (brand NR) on mattresses, pillows - Education provided by nurses in clinic	Der p or f Bla g Fel d Can f Mus m Mold	*Type of study:* RCT *Total population:* 309 *Attrition:* 12% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 8 *Age (range)*: NR; eligible patients age 3–13 *% Male:* 64% *Race:* 48% Hispanic; 20% African-American; 11% White; 11% Vietnamese; 6% Other Asian *Homeownership:* 23% *Geographic environment:* Urban	*Sensitization:* 61% had positive skin test to at least one allergen *Asthma severity:* 9% severe; 30% moderate; 41% mild persistent; 20% mild intermittent *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 23% *Smoker in home:* 42%

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Bryant-Stephens et al. 2008[50]	*Intervention:* - Hypoallergenic covers (brand NR) on mattresses, pillows - Cockroach and mouse bait - Carpet removal if applicable and preferred by family - Vacuum cleaner bags and cleaning supplies - Education and instruction from community health workers *Control 1:* Randomized to receive no intervention *Control 2:* Patients who declined consent for the study were enrolled in a case-matched control group with no intervention	Der p or f Bla g Fel d Can f Mus m	*Type of study:* RCT *Total population:* 281 in intervention and control group 1; 115 in control group 2 *Attrition:* 29% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 6 *Age (range)*: NR; eligible patients age 2–16 *% Male:* 60% *Race:* 100% African American *Homeownership:* 39% *Geographic environment:* Urban	*Sensitization:* NR *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* 49% *Cat/dog in home:* NR *Smoker in home:* NR
Parker et al. 2008[51]	*Intervention:* - Impermeable covers (brand NR) on mattresses, pillows - HEPA filtered vacuum (Eureka SmartVac) - Household cleaning supplies provided - Integrated pest management - Education and instruction from community health workers *Control:* No interventions	Der p or f Bla g Fel d Can f Mus m	*Type of study:* RCT *Total population:* 298 *Attrition:* 24% *Age cohort:* Child *Setting:* Home *Country:* U.S. *Followup:* 3 months	*Age (mean):* 9 *Age (range)*: NR; eligible patients age 7–11 *% Male:* 58% *Race:* 81% African American; 10% Latino; 4% Caucasian *Homeownership:* 36% *Geographic environment:* Urban	*Sensitization:* 38% Der p or f; 21% Bla g; 23% Fel d; 8% Can f; 13% Mus m *Asthma severity:* 48% moderate-severe; 28% mild persistent; 20% mild intermittent *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 38%
Burr et al. 2007[52]	*Intervention:* - 2-step mold removal process: 1) application of aqueous preparation (RLT Bactdet) containing detergent and fungicide (sodium dichlorophen) to remove mold from surfaces; 2) application of surface-penetrating aqueous preparation (RLT Halophen) containing fungicide (dialkyl dimethylammonium chloride) - Installation of positive ventilation fan (Drimaster) *Control:* No intervention	Mold	*Type of study:* RCT *Total population:* 232 patients, 164 houses *Attrition:* 22% *Age cohort:* Mixed *Setting:* Home *Country:* U.K. *Followup:* 1 year	*Age (mean):* 27 *Age (range)*: 3–61 *% Male:* NR *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 41% patients mold-sensitized *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 39% of homes had at least one smoker

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Kercsmar et al. 2006[53]	*Intervention:* - Removal of mold from hard surfaces - Preventive measures against mold growth and moisture infiltration tailored to each patient's house; examples of interventions include: repair of leaks, disconnection and redirection of downspouts, furnace repairs, improving air exhaust from kitchens and bathrooms, and similar efforts *Control:* No intervention	Mold	*Type of study:* RCT *Total population:* 62 *Attrition:* 18% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 7 *Age (range)*: NR; eligible patients age 2–17 *% Male:* 60% *Race:* 76% Black; 23% White *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* 31% mold-sensitized; 29% Der p or f; 16% Bla g; 11% Mus m *Asthma severity:* 11% severe; 19% moderate; 48% mild; 21% intermittent *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 39% any pet *Smoker in home:* 31%
Williams et al. 2006[54]	*Intervention:* - Impermeable covers (brand NR) on mattresses, pillows, box springs - Pest control with hydramethylnon gel - One-time professional cleaning of homes at outset of study - Education and instruction from community health workers - If applicable and preferred by family, any of the following: carpet removal; pet removal or bathing; removal of fungal growth; control of moisture/humidity *Control:* Education from community health workers, but no interventions	Der p or f Bla g Fel d Can f	*Type of study:* RCT *Total population:* 161 *Attrition:* 77% *Age cohort:* Child *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 8 (median) *Age (range)*: NR; eligible patients age 5–12 *% Male:* 59% *Race:* 99% Black *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* 58% Der p or f; 36% Bla g; 18% Fel d; 15% Can f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 50%
Eggleston et al. 2005[55]	*Intervention:* - Impermeable covers (Mission: Allergy) on mattresses, pillows - HEPA filter in bedroom - Integrated pest management (including fipronil bait gel for cockroach and bromdialone bait traps for mouse) - Education and instruction from community health workers *Control:* No interventions	Der p or f Bla g Fel d Mus m	*Type of study:* RCT *Total population:* 100 *Attrition:* 9% *Age cohort:* Child *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 8 *Age (range)*: 6–12 *% Male:* 46% *Race:* 99% African American *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* 29% Der p or f; 42% Bla g; 22% Fel d; 9% Mus m *Asthma severity:* 24% moderate-severe symptoms *Comorbidity:* NR *Carpeted bedrooms*: 43% *Cat/dog in home:* 39% *Smoker in home:* 69%

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Krieger et al. 2005[56]	*Intervention:* - Impermeable covers (brand NR) on mattresses, pillows - Low emission vacuum (brand NR) - Rodent traps and roach bait - Cleaning kits - Commercial-quality door mats - Education and instruction from community health workers, including up to 9 home visits *Control:* - Impermeable covers (brand NR) on mattresses, pillows - Single visit from community health worker for education - Patients were offered all interventions at study conclusion	Der p or f Bla g Fel d Can f Mus m Mold	*Type of study:* RCT *Total population:* 274 *Attrition:* 22% *Age cohort:* Child *Setting:* Home *Country:* U.S. *Followup:* 6 months	*Age (mean):* 7 *Age (range)*: NR; eligible patients age 4–12 *% Male:* 59% *Race:* 30% African American; 24% Vietnamese; 17% Hispanic; 17% White; 7% Other Asian *Homeownership:* 18% *Geographic environment:* Urban	*Sensitization:* NR *Asthma severity:* 28% severe; 34% moderate; 14% mild persistent; 24% mild intermittent *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 24% *Smoker in home:* 42%
Morgan et al. 2004[57] Pongracic et al. 2008[58]	*Intervention:* - Impermeable covers (Allergy Control Products) on mattresses, pillows, box springs - HEPA filtered vacuum (Miele) - HEPA air purifier (Holmes Products) for patients exposed to pets, mold, or tobacco smoke - Professional pest control (Terminix) *Control:* No interventions	Der p or f Bla g Fel d Can f Mus m Mold	*Type of study:* RCT *Total population:* 937 *Attrition:*12% *Age cohort:* Child *Setting:* Home *Country:* U.S. *Followup:* 2 years	*Age (mean):* 8 *Age (range)*: 5–11 *% Male:* 63% *Race:* 40% Black; 40% Hispanic *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* 63% Der p or f; 69% Bla g; 44% Fel d; 22% Can f; 33% Mus m; 50% mold *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 22% dog, 18% cat *Smoker in home:* 48%
Carter et al. 2001[59]	*Intervention:* - Impermeable covers (Allergy Control Products) on mattresses, pillows - Cockroach bait (Combat) - Instruction to wash bedding weekly in hot water, and education about cleaning to control house dust mites and cockroaches *Control 1:* - Placebo covers on mattresses, pillows - Ineffective cockroach bait - Instruction to wash bedding in cold or cool water *Control 2: N*o intervention or placebo	Der p or f Bla g	*Type of study:* RCT *Total population:* 104 *Attrition:* 18% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 11 *Age (range)*: 6–16 *% Male:* NR *Race:* NR, but enrolling clinic treats population that is 92% African American *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* 74% Der p or f; 56% Bla g; 26% Fel d 2% Mus m *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Htut et al. 2001[60]	*Intervention 1:* - Steam heating applied to mattresses, duvets, upholstered furniture, carpet - New pillows provided - Linens washed *Intervention 2:* - Steam heating as in Group 1 - Installation of positive ventilation system (Nuaire) above bedroom *Control:* Placebo treatment of surfaces	Der p or f	*Type of study:* RCT *Total population:* 30 *Attrition:* 23% *Age cohort:* Adult *Setting:* Home *Country:* U.K. *Followup:* 1 year	*Age (mean):* NR *Age (range)*: NR; eligible patients age 18–45 *% Male:* NR *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR
Warner et al. 2000[61]	*Intervention 1:* - Installation of whole-house mechanical ventilation system with heat recovery (ADM Indux) - HEPA vacuums (Miele) *Intervention 2:* Ventilation system only *Intervention 3:* HEPA vacuum only *Control:* No interventions	Der p or f	*Type of study:* RCT *Total population:* 40 *Attrition:* NR *Age cohort:* Mixed *Setting:* Home *Country:* U.K. *Followup:* 1 year	*Age (mean):* 27 children*:* mean 10 years; 13 adults*:* mean 40 years *Age (range)*: 4–67 *% Male:* 65% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* All patients moderate or severe *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR
Cloosterman et al. 1999[62]	*Intervention:* - Impermeable covers (Intervent Bedding Systems) on mattresses, pillows, duvets - Carpet treated with Acarosan powder (benzyl benzoate 5%) *Control:* - Mattresses et al. covered with cotton placebos - Carpet treated with water spray	Der p or f	*Type of study:* RCT *Total population:* 157 *Attrition:* 23% *Age cohort:* Adult *Setting:* Home *Country:* The Netherlands *Followup:* 20 weeks	*Age (mean):* 33 versus 34 *Age (range)*: NR; eligible patients age 16–60 *% Male:* 57% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* 66% *Cat/dog in home:* NR *Smoker in home:* 18%
Evans et al. 1999[63]	*Intervention:* - Impermeable covers (brand NR) on mattresses, pillows - Professional application of abamectin insecticide in homes of patients with positive Bla g skin test - Monthly contact with social workers to discuss allergen control, symptom management, access to medical care *Control:* No intervention	Der p or f Bla g	*Type of study:* RCT *Total population:* 1,033 *Attrition:* 7% at 1 year, 14% at 2 years *Age cohort:* Child *Setting:* Home *Country:* U.S. *Followup:* 2 years	*Age (mean):* 8 *Age (range)*: 5–11 *% Male:* 64% *Race:* 75% Black, 17% Hispanic *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* 86% sensitized to at least one allergen *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 42%
Shapiro et al. 1999[64]	*Intervention:* - Impermeable covers (Allergy Control Products, Inc.) on mattresses, pillows, box springs - Laundry service delivery of clean blanket and linens monthly - Carpet treated with tannic acid *Control:* Carpet treated with placebo	Der p or f	*Type of study:* RCT *Total population:* 44 *Attrition:* 11% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 1 year	*Age (mean):* 10 versus 9 *Age (range)*: 6–15 *% Male:* 39% *Race:* 58% White, 25% African-American, 17% Other *Homeownership:* NR *Geographic environment:* Urban	*Sensitization:* 100% Der p or f *Asthma severity:* Mild or Moderate *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Hayden et al. 1997[65]	*Intervention:* - Impermeable covers (Allergy Control Products) on mattresses, pillows, box springs - Carpet in bedroom replaced with hardwood or vinyl flooring - Carpet in living room or family room treated with 3% tannic acid spray every 3 months - Instruction to wash bedding weekly in hot water *Control:* - Placebo cotton covers on mattresses, pillows, box springs - Carpet treated with water spray - Instruction to wash bedding in cold water	Der p or f Bla g Fel d	*Type of study:* RCT *Total population:* 23 *Attrition:* 8% *Age cohort:* Mixed *Setting:* Home *Country:* U.S. *Followup:* 6 months	*Age (mean):* 9 *Age (range)*: 5–16 *% Male:* 61% *Race:* 52% White, 48% African American *Homeownership:* 87% *Geographic environment:* Suburban	*Sensitization:* 65% Der p or f; 9% Bla g; 13% Fel d *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 30% indoor pet *Smoker in home:* 22%
Carswell et al. 1996[66]	*Intervention:* - Mattresses, pillows, duvets, and upholstered furniture vacuumed, then treated with Acarosan foam (benzyl benzoate 2.6%) - Cotton covers coated with polyurethane on mattresses, pillows, duvets - Bed linen washed at 60° C - Carpet vacuumed, treated with Acarosan powder (benzyl benzoate 5%) - Soft toys removed or washed *Control:* - Mattresses et al. treated with water spray - Mattresses et al. covered with cotton placebos - Bed linen washed at 40° C - Carpet treated with chalk dust	Der p or f	*Type of study:* RCT *Total population:* N=70 *Attrition:* 13% *Age cohort:* Child *Setting:* Home *Country:* U.K. *Followup:* 24 weeks	*Age (mean):* 10 *Age (range)*: 7-10 *% Male:* 63% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* 10% *Smoker in home:* NR
Marks et al. 1994[67]	*Intervention:* - Mattresses, pillows, duvets, blankets, and furniture treated with a tannic acid/acaricide solution (Allersearch DMS), applied by hand-held spray pump - Impermeable covers (Coolguard and Medisoft) on mattresses, pillows, duvets - Carpet treated with same tannic acid/acaricide solution *Control:* Mattresses et al. treated with inactive placebo spray	Der p or f	*Type of study:* RCT *Total population:* 35 *Attrition:* 14% *Age cohort:* Adult *Setting:* Home *Country:* Australia *Followup:* 6 months	*Age (mean):* 34 versus 37 *Age (range)*: NR; eligible patients age 13-60 *% Male:* 49% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 94% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* 1 smoker

Table C-20. Study characteristics of multicomponent studies (continued)

Study	Intervention	Allergen	Study Design	Demographic Factors	Clinical Factors
Walshaw et al. 1986[68]	*Intervention:* - Plastic covers on mattresses, pillows - Feather duvets, quilts and woolen blankets replaced with other materials - Bedroom carpet either replaced with linoleum or vacuumed regularly *Control:* No intervention	Der p or f	*Type of study:* RCT *Total population:* 50 *Attrition:* 16% *Age cohort:* Adult *Setting:* Home *Country:* U.K. *Followup:* 1 year	*Age (mean):* 33 *Age (range)*: NR *% Male:* 44% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR
Korsgaard 1983[69]	*Intervention:* - Mattress vacuumed 2 times per week - Linens laundered 2 times per week - All pillows and quilts replaced with synthetic products - Carpet replaced with linoleum or wood flooring; floor cleaned 2 times per week - Bedroom and living room aired out for 20 minutes per day - Clothes dried outdoors when possible *Control:* No interventions	Der p or f	*Type of study:* RCT *Total population:* 46 *Attrition:* 0% *Age cohort:* Adult *Setting:* Home *Country:* Denmark *Followup:* 6 months	*Age (median):* 30 *Age (range)*: NR; eligible patients age 15+ *% Male:* 70% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* 85% *Cat/dog in home:* NR *Smoker in home:* NR
Burr et al. 1980[70]	*Intervention:* - Mattress vacuumed weekly - Blankets laundered at beginning of study, then beaten in open air every 2 weeks - Linens laundered weekly - Feather pillows replaced with synthetic pillows, or encased in impermeable covers, and beaten in open air weekly - Quilts removed - Soft toys removed, or washed, brushed, and vacuumed weekly - Carpet in bedroom vacuumed several times per week, while upholstered furniture vacuumed every 2 weeks *Control:* - Special dusters issued for dusting - Upholstered furniture vacuumed or brushed 2 times per week - Carpet vacuumed daily	Der p or f	*Type of study:* RCT *Total population:* 53 *Attrition:* 4% *Age cohort:* Mixed *Setting:* Home *Country:* U.K. *Followup:* 8 weeks	*Age (mean):* 9 *Age (range)*: 4-14 *% Male:* 68% *Race:* NR *Homeownership:* NR *Geographic environment:* NR	*Sensitization:* 100% Der p or f *Asthma severity:* NR *Comorbidity:* NR *Carpeted bedrooms:* NR *Cat/dog in home:* NR *Smoker in home:* NR

Bla g=*blatella germanica* allergen; Can f=*canis familiaris* allergen; Der f=*dermatophagoides farina* allergen; Der p=*dermatophagoides pteronyssinus* allergen; Fel d=*felis catus* allergen; HEPA=high efficiency particulate air; NR=not reported; RCT=randomized controlled trial; U.K.=United Kingdom; U.S.=United States

Table C-21. Outcomes of multicomponent studies

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
DiMango et al. 2016[41]	ACT Score (mean) No difference: 20.1 (SE 0.38) vs. 20.9 (SE 0.40), p=0.12) No difference in childhood ACT: 22.6 (SE 0.58) vs. 22.9 (SE 0.62), p=0.71	**Exacerbations** No difference in patients reporting exacerbations (criteria NR): 8 vs. 8 (p=0.96) **Rescue inhaler days/2 weeks (mean)** No difference in use of rescue inhaler, days per 2 weeks: 2.32 (SE 0.23) vs. 2.15 (SE 0.24), p=0.61	**FEV_1**, (mean) No difference: 89.8 (SE 1.58) vs. 89.2 (SE 1.64), p=0.79	**Juniper mini-AQLQ** (mean) No difference: 5.41 (SE 0.13) vs. 5.63 (SE 0.14), p=0.26	No difference in mean composite asthma score (components NR): 5.64 (SE 0.25) vs. 5.66 (SE 0.27), p=0.97 No difference in mean incidence of nighttime awakening: 1.08 (SE 0.16) vs. 0.81 (SE 0.17), p=0.26 No difference in treatment step: 3.50 (SE 0.16) vs. 3.43 (0.17), p=0.76	No between-group comparison Significant reduction from baseline for all allergens in intervention group: Der f 1, p<0.01; Bla g 2 in bed, p<0.01; Bla g 2 in kitchen, p<0.01; Fel d 1, p=0.01; Can f 1, p=0.03; Mus m 1 in bed, p<0.01; Mus m 1 in kitchen, p=0.02 Significant reduction from baseline for 3 allergens in control group: Der f 1, p=0.04; Bla g 2 in kitchen, p<0.01; Mus m 1 in bed, p=0.03; no difference for other allergens
Shani et al. 2015[42]	**ACT and CACT score** No improvement in ACT score (mean increase over baseline: 2.31, SE: 1.15, p=0.06) or CACT score (mean increase: 0.94, SE: 0.52, p=0.08) In subgroup analysis of patients with "severe" baseline scores below 20, there was significant improvement in ACT score (mean increase: 4.22, SE: 1.83, p=0.05) and CACT score (mean increase: 3.45, SE: 0.81, p<0.01)	**ED visits** (mean difference) Significant reduction: -0.51, SE: 0.18 (p<0.01) **Hospitalizations** (mean difference) No difference: -0.18, SE: 0.12 (p=0.14) **Doctor visits** (mean difference) No difference: -0.11, SE: 016 (p=0.48) **Use of rescue medication** (mean difference) Significant reduction: -1.00, SE: 0.50 (p<0.05) **Missed school days** (mean difference) Significant reduction: -4.73, SE: 1.73 (p<0.01)	NR	NR	NR	NR

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Breysse et al. 2014[43]	NR	**Asthma attacks, use of urgent care, use of rescue medicine** No difference between groups, but significant improvement over baseline in intervention group **Days with limited activity** No difference between groups, but significant improvement over baseline	NR	**PACQLQ** Significant improvement compared to control (p<0.01)	Significant improvement in intervention group vs. control group for "asthma not well controlled or very poorly controlled" (decrease of 71% from baseline vs. decrease of 48%, p<0.05) No difference between groups for symptom-free days (p=0.67), nights with symptoms (p=0.38) Significant improvement over baseline in symptom-free days, and nights with symptoms (p<0.01), within both groups	No between-group comparison No significant reduction in Der p 1, (decrease from 75% to 44%, p=0.06); Der p 2 (decrease from 94% to 75%, p=0.83); Bla g 1 (no change), and Mus m 1 (increase from 25% to 62% in kitchen (p=0.14) and increase from 37% to 81% in living room, p=0.08)
Turcotte et al. 2014[44]	**CHSA** mean score improved in all 5 domains Episodes of wheezing/4 weeks decreased from 6.40 to 2.30	**ED visits/4 weeks** (mean) Decreased from 0.20 to 0.04 **Hospitalizations/4 weeks** (mean) Decreased from 0.05 to 0.00 **Asthma attacks/4 weeks** (mean) Decreased from 0.80 to 0.20 **Doctor visits/4 weeks** (mean) Decreased from 0.70 to 0.20 Authors report that all improvements were statistically significant, but analysis not shown	NR	NR	NR	NR

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Sweet et al. 2013[45]	NR	**ED visits/3 months** (mean) Significant reduction, mean ED visits/3 months: 0.50 (SD 0.67) vs. 1.17 (SD 3.06); p<0.01 **Hospitalizations/3 months** (mean) No difference: 0.08 (SD 0.53) vs. 0.15 (SD 0.67); p=0.33 **Albuterol use/2 weeks** (mean) Significant reduction: 2.17 (SD 3.24) vs. 4.58 (SD 4.73); p<0.01 **Days with limited activity/2 weeks** (mean) Significant reduction: 1.62 (SD 3.53) vs. 3.84 (SD 4.61); p<0.01 **Missed school days/6 months** (mean) Significant reduction: 2.81 (SD 5.94) vs. 6.24 (SD 12.82); p<0.01 **Missed work days/6 months** (mean) Significant reduction: 0.83 (SD 1.70) vs. 3.41 (SD 4.58); p<0.05	NR	**Survey** Significant improvement in responses to 7 of 9 questions on caregiver quality of life survey	Significant reduction in mean symptom days/2 weeks: 2.66 (SD 3.86) vs. 5.01 (SD 4.27); p<0.01 Significant reduction in mean nighttime awakenings/2 weeks: 1.31 (SD 2.72) vs. 3.18 (SD 3.91); p<0.01	NR
El-Ghitany et al. 2012[46]	NR	**Number of hospitalizations**, median (interquartile range), compared to baseline Physical: 0.50 (0 to 1); p<0.01 vs. Control: 1.3 (1 to 2); p=0.58	Between-groups analysis not presented. Comparison to baseline. **Change in peak flow**, mean 6.82 (p<0.01) vs. 1.62 (p<0.01) **FEV1**, mean difference 2.55 (p<0.01) vs. -0.15 (p=0.73)	NR	NR	Between-groups analysis not presented. Levels of HDM decreased significantly in all intervention groups relative to baseline. Der p 1 concentration in dust, mcg/g^{-1} (SD): 6.17 (0.61) vs. control 6.28 (0.67)
Takaro et al. 2011[47]	NR	**Urgent care use, asthma attacks, rescue medicine use** No difference between groups	**FEV_1** No difference between groups (p=0.93) but significant improvement over baseline in both groups	**PACQLQ** No difference between groups, but significant improvement over baseline within groups	No difference between groups for symptom-free days (p=0.53) but significant improvement over baseline within both groups Significant improvement in nights with symptoms for intervention group vs. control group (p=0.44)	NR

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Bryant-Stephens et al. 2009[48]	NR	**ED visits** (estimated difference) No difference between groups: 0.02, SD 0.13 (p=0.89) but significant decrease from baseline within both groups **Hospitalizations** No difference between groups: -0.04, SD 0.16 (p=0.81) but significant decrease from baseline within both groups	NR	NR	No difference between groups for nighttime cough (p=0.11) or wheeze (p=0.32), but significant improvement from baseline within each group	NR
Krieger et al. 2009[49]	NR	**Need for urgent health care** No difference between groups: OR: 0.69 (95% CI: 0.38–1.26, p=0.23) but significant reduction within each group: decrease of 23% vs. 18% (p<0.01) **Asthma attacks/3 months** (mean) No difference between groups (p=0.07) but significant reduction of 1.8 from baseline within intervention group **Use of beta-agonist/2 weeks** (mean days) No difference between groups (p=0.18) but significant reduction of 1.6 days from baseline within intervention group **Reduced activity days/2 weeks** (mean) No difference between groups (p=0.46) but significant reduction from baseline within each group **Missed school days/2 weeks** No difference between groups: OR: 0.81 (95% CI: 0.35–1.88, p=0.62) but significant reduction within each group **Missed work days/2 weeks** No difference between groups: OR: 0.60 (95% CI: 0.20–1.78, p=0.35) but significant reduction within each group	NR	**PACQLQ** Significantly larger improvement compared with control: 0.6 points vs. 0.4 (p<0.05)	**Symptom days/2 weeks** Significantly fewer days with symptoms (wheeze, cough, tightness in chest, shortness of breath, slowing down activity, nighttime awakening) between groups: 1.9 vs. 1.3 (p<0.05)	NR

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Bryant-Stephens et al. 2008[50]	NR	**ED visits** No difference between intervention group and control 1 (no intervention): p=0.99 but significant reduction compared with control 2 (matched case-control patients): p<0.01 Significant improvement from baseline within intervention group: decrease of 0.97 (p<0.01) **Inpatient days** No difference between intervention group and control 1 (no intervention): p=0.95 but significant reduction compared with control 2 (matched case-control patients): p<0.05 Significant improvement from baseline within intervention group: decrease of 0.29 (p<0.01) **Sick visits** No difference between intervention group and control 1 (no intervention): p=0.26 but significant reduction compared with control 2 (matched case-control patients): p<0.05 Significant improvement from baseline within intervention group: decrease of 0.48 (p<0.01)	NR	NR	No difference between groups for daytime and nighttime cough and wheeze, but significant improvement from baseline within both groups	NR

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Parker et al. 2008[51]	NR	**Needed unscheduled medical care** (mean) Significant decrease: OR 0.40 (95% CI: 0.22–0.74, p<0.01)	**Peak flow** Significant increase in daily PF% predicted: intervention effect 8.2 (95% CI: 1.1–15.2, p=0.02) No significant difference in PFV: intervention effect -2.1 (95% CI: -5.0–0.8, p=0.15) **FEV_1:** Significant increase over baseline: intervention effect 10.0 (95% CI: 0.9–19.1, p=0.03)	**Caregiver depressive symptoms** Significant reduction (p=0.02)	Significant decrease in persistent cough (p=0.03) Significant decrease in cough with exercise (p=0.02) No significant differences in wheeze, shortness of breath, chest tightness or heaviness, or sleep disturbance (data NR) Significant decrease in presence of any symptom more than 2 days/week, without controller medication: OR 0.39 (95% CI: 0.20–0.73, p<0.01)	Significant reduction in Can f allergen (p<0.01) but not Der p or f, Fel d, or Mus m (data NR)
Burr et al. 2007[52]	NR	**Asthma relief medication use/4 weeks** 20% of intervention group reported reduced need vs. 2%	**Peak flow variability** No difference between groups. 52% of intervention group reported improvement in breathing, vs. 24% in control group	NR	28% of intervention group reported lower likelihood of wheezing affecting activities, vs. 22%	NR
Kercsmar et al. 2006[53]	No difference in mean CHSA scores between groups (data reported in figure) and season	**Acute care visits** (mean) No significant difference: 0.28 (SD 0.80) vs. 0.91 (SD 1.79), p=0.06	NR	NR	Significant reduction in symptom days for intervention group vs. control (p<0.01, data reported in figure) after adjusting for baseline severity	Significant reduction in mean mold scores between groups: 0.75 (SD 0.99) vs. 1.68 (SD 1.32), p<0.01

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Williams et al. 2006[54]	NR	NR	NR	NR	Overall symptoms did not differ between groups (data not shown) Significant decrease in median functional severity score component of symptom scale (wheeze, nighttime awakening, occurrence of severe asthma attack, limited home and sports activities): 33% vs. 20% (p<0.01)	Significant reduction in Der p 1 and Der f 1 on mattresses (p<0.05; data reported in figure) Significant reduction in Bla g 1 at 4 and 8 months but not 12 months (data reported in figure)
Eggleston et al. 2005[55]	NR	**Acute care visits** No difference: 15% reduction for intervention vs. 13% reduction **Hospitalizations** No difference (data NR)	NR	No difference in quality of life score (scale not described): mean score 4.70 vs. 5.00	Significant improvement in presence of daytime symptoms: 3% decrease vs. 9% increase (p<0.05) No difference between groups in nighttime symptoms, symptoms with exercise, or interference with activity	No difference for Der p, Der f, Bla g, Fel d, Mus m
Krieger et al. 2005[56]	NR	**Need for urgent care** (mean) Significant decrease: OR 0.38 (95% CI: 0.16–0.89, p=0.03) **Medication use** (mean) No difference in use of beta-agonist (p=0.78) or controller medication (p=0.25) **Days with limited activity/2 weeks** (mean) Significant decrease: coefficient 0.22 (95% CI: 0.06–0.86, p=0.03) **Missed school days** No difference: OR 0.46 (95% CI: 0.18–1.18, p=0.11) **Missed work days** No difference: OR 1.07 (95% CI: 0.40–2.85, p=0.89)	NR	**PACQLQ** Significant improvement: mean score increased over baseline by 1.6 points vs. 1.0 (p<0.01)	**Symptom days/2 weeks** (mean) No difference between groups (p=0.14), but significant decrease within each group: 4.8 and 3.9 (p<0.01 within groups) in days with symptoms (wheeze, cough, tightness in chest, shortness of breath, slowing down activity, nighttime awakening)	NR

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Morgan et al. 2004[57] Pongracic et al. 2008[58]	NR	**Unscheduled ED or clinic visits per year** (mean) Significantly fewer at 1-year followup: 2.22 (SE 0.12) vs. 2.57 (SE 0.13), p=0.04 No difference at 2-year followup: 1.39 (SE 0.10) vs. 1.66 (SE 0.10), p=0.07 **Hospitalizations** No difference at 1-year followup: 17.1% vs. 15.5%, p=0.56 or 2-year followup: 10.6% vs. 13.5%, p=0.19 **Reduced activity days/2 weeks** (mean) Significantly fewer at 1-year followup: 2.34 (SE 0.10) vs. 2.84 (SE 0.10), p<0.01 and at 2-year followup: 1.67 (SE 0.10) vs. 2.13 (SE 0.10), p<0.01 **Missed school days/2 weeks** (mean) Significantly fewer at 1-year followup: 0.65 (SE 0.04) vs. 0.82 (SE 0.04), p<0.01 and at 2-year followup: 0.54 (SE 0.04) vs. 0.71 (SE 0.04), p<0.01 **Days caretaker changed plans/2 weeks** (mean) No difference at 1-year followup: 0.91 (SE 0.07) vs. 1.22 (SE 0.07), p<0.01 or at 2-year followup: 0.72 (SE 0.06) vs. 0.87 (SE 0.06), p=0.09	**FEV_1** No difference: 87.0 (SE 0.77) vs. 87.4 (SE 0.78), p=0.69 at 1-year followup	NR	**Symptom days/2 weeks** (mean), 1-year followup Significantly fewer days with symptoms (wheeze, cough, tightness in chest): 3.39 (SE 0.12) vs. 4.20 (SE 0.12), p<0.01 Significantly fewer days with wheeze: 2.65 (SE 0.11) vs. 3.43 (SE 0.11), p<0.01 Significantly fewer nighttime awakenings: 1.55 (SE 0.08) vs. 2.17 (SE 0.08), p<0.01 **2-year followup** Significantly fewer days with symptoms (wheeze, cough, tightness in chest): 2.62 (SE 0.12) vs. 3.21 (SE 0.13), p<0.01 Significantly fewer days with wheeze: 2.28 (SE 0.11) vs. 2.87 (SE 0.11), p<0.01 Significantly fewer nighttime awakenings: 1.27 (SE 0.08) vs. 1.57 (SE 0.08), p=0.01	Der p 1 on bed: Significantly greater reduction at 1 year: 37% vs. 18% (p<0.01), but not at 2 years: 37% vs. 25% (p=0.11) Der p 1 on floor: No difference at 1 year: 21% vs. 13% (p=0.28) or 2 years: 34% vs. 24% (p=0.20) Der f 1 on bed: Significantly greater reduction at 1 year: 59% vs. 14% (p<0.01), and at 2 years: 49% vs. 25% (p<0.01) Der f 1 on floor: Significantly greater reduction at 1 year: 34% vs. 10% (p<0.01) but not at 2 years: 18% vs. 13% (p=0.66) Bla g 1 on bed: No difference at 1 year: 44% vs. 34% (p=0.13) or at 2 years: 51% vs. 46% (p=0.39) Bla g 1 on floor: Significantly greater reduction at 1 year: 52% vs. 19% (p<0.01), and at 2 years: 64% vs. 47% (p<0.01) Fel d 1 on bed: Significantly greater reduction at 1 year: 28% vs. 15% increase (p<0.01) and at 2 years: 14% vs. 30% increase (p<0.01) Fel d 1 on floor: Significantly greater reduction at 1 year: 14% vs. 15% increase (p=0.02) but not at 2 years: 13% vs. 11% increase (p=0.08) Can f 1 on bed: No difference at 1 year: 10% increase vs. 24% increase (p=0.29) or at 2

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
						years: 65% increase vs. 90% increase (p=0.28) Can f 1 on floor: No difference at 1 year: 10% increase vs. 18% increase (p=0.56) or at 2 years: 58% increase vs. 82% increase (p=0.33)
Carter et al. 2001[59]	NR	**Need for acute care** (including ED visit, hospitalization, clinic visit) No difference between intervention and control 1 Significantly larger decrease for both intervention group (33% decrease) and control group 1 (30% decrease), vs. control group 2 (6% increase), p<0.01	NR	NR	NR	NR
Htut et al. 2001[60]	NR	NR	**PD_{20}** Significant improvement from baseline for Intervention Group 2 (p=0.05, data reported in figure) Significant improvement from baseline for Intervention Group 1 at 9 months, but not 12 months In Control Group, PD_{20} decreased from baseline but not significantly	NR	NR	Significant reduction in mean Der p 1 on mattresses or carpets for Intervention Group 1: decrease from 7.4 (SD 1.3) to 3.3 (SD 1.6) and for Intervention Group 2: decrease from mean 6.5 (SD 1.4) to 2.2 (SD 1.8) No change over baseline for Control Group (data reported in figure)

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Warner et al. 2000[61]	NR	NR	**Peak flow** No difference between groups (data NR) **PC_{20}** No difference between groups (data reported in figure)	NR	No difference between groups in symptom scores (data NR)	Ventilation associated with reduced Der p 1 on bedroom carpets (p<0.01), mattresses (p=0.03), and sofas (p=0.03), but not living room carpets HEPA vacuum associated with reduced Der p 1 on bedroom carpets (p=0.04) but not other surfaces
Cloosterman et al. 1999[62]	NR	NR	**Peak flow variability** No difference: p=0.62, data reported in figure **FEV_1** No difference: p=0.82, data reported in figure	NR	No difference in symptom score (sleep disturbance, cough, breathlessness, wheeze, expectoration, tiredness): p=0.55, data reported in figure	Significant reduction in Der p 1 on mattresses: 9.4% of baseline at followup vs. 68.5% of baseline (p<0.01)
Evans et al. 1999[63]	NR	**Hospitalizations** No difference at 1 year: 15% vs. 19% (p=0.07) or at 2 years: 10% vs. 14% (p=0.08) **Unscheduled visits per year**, mean No difference at 1 year: 2.64 vs. 2.85 (p=0.32) or at 2 years: 1.89 vs. 2.24 (p=0.08)	NR	NR	Significantly fewer symptom days/2 weeks: 3.51 vs. 4.06 (p<0.01) at 1 year; 2.64 vs. 3.16 (p<0.01) at 2 years	NR
Shapiro et al. 1999[64]	NR	No difference in hospitalizations, emergency department visits, steroid bursts (data NR)	**FEV_1** No difference (data NR) **PD_{20}** Significant increase in doubling of PD_{20} methacholine: 47% vs. 23% (p<0.05)	No difference in 14-point quality of life scale (name of scale and data NR)	No difference in symptom score (components not described; data NR)	No difference in Der p 1: reduction from baseline of 20% vs. 33% (p=0.20) Allergen concentrations were categorized as low (<2 µg/g dust), moderate (2 to <10 µg/g dust), or high (≥10 µg/g dust). Significantly more homes in intervention group moved to a lower category: 50% vs. 17% (p=0.03)

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Hayden et al. 1997[65]	NR	NR	**Peak flow** Significantly greater improvement: 15.1% increase vs. 4.4% decrease (p<0.05) **FEV_1** No significant difference: 83% vs. 86%	NR	NR	NR
Carswell et al. 1996[66]	NR	**Medication use** Significantly less use of any asthma medication: 50% vs. 80% (p<0.02) Significantly less bronchodilator use: 17% vs. 54% (p<0.01) No difference in use of inhaled steroid: 13% vs. 35% (p=n.s.)	**Peak flow** No difference (data reported in figure) **FEV_1** Significantly greater improvement in intervention group: 2.3% vs. -3.2 (p<0.05)	NR	Significantly fewer patients in intervention group reported any asthma symptoms compared with control, but no difference between groups in daytime wheeze or cough (data reported in figure)	Significant reduction in Der p 1 on mattresses: decrease over baseline from 480 ng to 0 ng (p<0.01)
Marks et al. 1994[67]	NR	NR	**Peak flow variability** No difference: 1.3 vs. 1.2 (p=0.94) **FEV_1** No difference: change from baseline of 4.37 vs. 2.80 (p=0.72)	NR	No difference in symptom score (sleep disturbance, cough, chest tightness, wheeze, breathlessness): 0.14 vs. -0.06 (p=0.20)	No difference in Der p 1 in beds (p=0.76, data reported in figure)
Walshaw et al. 1986[68]	NR	**Inhaled steroids** (inhalations/day) No between-group comparison Significant decrease from baseline within intervention group: 1.83 to 1.00 (control group decreased from 2.80 to 2.40)	**Peak flow** No between-group comparison Significant increase from baseline in intervention group: 391 l/min to 423 (control group decreased from 376 l/min to 372)	NR	Symptom components not described Authors' report "progressive improvement" in symptoms, but no significant difference between groups (data reported in figure)	Authors report a "significant and sustained" reduction in Der p or Der f on mattresses and bedroom floors, in the intervention group, while the control group had no change (all data reported in figures)

Table C-21. Outcomes of multicomponent studies (continued)

Study	Asthma Control	Exacerbations and Healthcare Utilization	Pulmonary Physiology	Quality of Life	Symptoms (secondary measure)	Allergen Levels (secondary measure)
Korsgaard 1983[69]	NR	**Use of terbutaline** Significant reduction in median number of daily puffs: decrease of 1.5 vs. 0.5 (p<0.05) No difference between groups on median nightly use of terbutaline: decrease of 1.5 vs. decrease of 0.5 (p=0.15) No difference between groups on amount of terbutaline used: decrease of 0.21 g/month vs. decrease of 0.31 g/month (p=0.16)	**Peak flow** No difference between groups on median PF change: morning PF increased from 460 to 490 vs. increase from 450 to 460 (p=0.33); evening PF increased from 470 to 490 vs. increase from 475 to 490 (p=0.82)	NR	Significantly greater reduction in median daily symptom score (cough, wheeze, shortness of breath): 6.0 vs. 1.5 (p<0.05) No difference in median nighttime symptom score: no change vs. decrease of 1.0 (p=0.07)	Significantly greater reduction in median Der p or Der f per 0.10 g dust sample on bedroom floor: decrease of 36 vs. increase of 27 (p<0.01) No difference in median Der p or Der f on living room floor: increase of 8 per 0.10 g dust sample vs. no change (p=0.68) No difference in median Der p or Der f on mattresses: increase of 67 per 0.10 g dust sample vs. increase of 20
Burr et al. 1980[70]	NR	NR	**Peak flow variability** No difference: 109.2 for intervention vs. 107.4 for morning readings; 107.7 vs. 105.5 for evening readings	NR	NR	NR

ACT=asthma control test; Bla g 1=*blatella germanica* cockroach allergen 1; CACT=children's asthma control test; Can f 1=*canis familiaris* allergen 1; CHSA=children's health survey for asthma; CI=confidence interval; Der f 1=*dermatophagoides farina* allergen I; Der p 1=*dermatophagoides pteronyssinus* allergen I; ED=emergency department; Fel d 1=*felis domesticus* allergen; FEV_1=forced expiratory volume in 1 second; HDM=house dust mite; Mus m 1=*Mus musculus* mouse allergen 1; NR=not reported; n.s.=not significant; OR=odds ratio; PACQLQ=pediatric asthma caregivers asthma quality of life questionnaire; PF=peak expiratory flow; SD=standard deviation; SE=standard error

Table-C-22. Risk of bias of multicomponent intervention RCTs

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
DiMango et al. 2016[41]	Unclear	Unclear	High	High	Low	Low	Low	Insufficient description of randomization; no blinding; attrition 16% but ITT analysis; pre-specified outcomes and subgroup analyses
El-Ghitany et al. 2012[46]	Low	Unclear	High	Low	Low	Low	Low	Allocation not described; patients not blinded but outcome assessors were; all patients completed followup
Bryant-Stephens et al. 2009[48]	Unclear	Unclear	High	High	High	Low	Low	Insufficient description of randomization; no blinding; 23% attrition
Krieger et al. 2009[49]	Low	Low	High	High	Low	Low	Low	No blinding; 12% attrition and ITT analysis; pre-specified outcomes reported
Bryant-Stephens et al. 2008[50]	Unclear	Unclear	High	Unclear	High	Low	Low	Insufficient description of randomization; no blinding of patients; most outcomes extracted from electronic health record but no description of whether extractors were blinded; 29% attrition
Parker et al. 2008[51]	Low	Unclear	High	High	High	Low	Low	No description of allocation; no blinding; 24% attrition and dropouts differed from completers on homeownership
Burr et al. 2007[52]	Unclear	Unclear	High	High	High	High	Low	Insufficient description of randomization; no blinding; 22% attrition
Kercsmar et al. 2006[53]	Low	Low	High	High	High	Low	Low	No blinding; 22% attrition
Williams et al. 2006[54]	Low	Unclear	High	Unclear	High	High	Low	No description of allocation; no blinding; unclear if outcome assessors were blinded; 77% attrition; major positive finding was a post-hoc analysis
Eggleston et al. 2005[55]	Unclear	Unclear	High	High	Low	Unclear	Low	Insufficient description of randomization; no blinding; 9 attrition; some data now shown and quality of life scales not described
Krieger et al. 2005[56]	Unclear	Unclear	High	High	High	Low	Low	Insufficient description of randomization; no blinding; 22% attrition
Morgan et al. 2004[57]	Low	Unclear	High	Low	Low	Low	Low	No description of allocation; patients not blinded, but study evaluators blinded; 12% attrition
Carter et al. 2001[59]	Unclear	Unclear	Low	Low	High	Low	Low	Insufficient description of randomization; placebo used; outcomes assessors blinded; 18% attrition;
Htut et al. 2001[60]	Low	Low	Low	Low	High	Low	High	Placebo used; outcomes assessors blinded; 23% attrition; ventilation equipment provided by manufacturer

Table C-22. Risk of bias of multicomponent intervention RCTs (continued)

Study	Sequence Generation	Allocation Concealment	Blinding Participants and Personnel	Blinding Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Warner et al. 2000[61]	High	Unclear	High	High	Unclear	High	Low	Randomization was suspended for several participants whose homes were not suited to one of the study arms; no description of allocation; no blinding; attrition not reported; not all data reported
Cloosterman et al. 1999[62]	Unclear	Unclear	Low	Low	High	Low	Low	Insufficient description of randomization; placebo used; 23% attrition; study funded in part by pharmaceutical manufacturers
Evans et al. 1999[63]	Low	Unclear	High	Low	Low	Low	Low	No description of allocation; outcomes assessors blinded but patients were not; low attrition
Shapiro et al. 1999[64]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo used; 11% attrition
Hayden et al. 1997[65]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo used; 8% attrition
Carswell et al. 1996[66]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo used;13% attrition
Marks et al. 1994[67]	Unclear	Unclear	Low	Low	High	Low	Low	Insufficient description of randomization; placebo used; 14% attrition but many data sets incomplete due to patients not completing daily symptom reports
Walshaw et al. 1986[68]	Unclear	Unclear	High	Unclear	Low	High	Low	Insufficient description of randomization; no blinding of patients; unclear in outcome assessors were blinded; some data or between-group comparisons not reported
Korsgaard 1983[69]	Unclear	Unclear	High	High	Low	Low	Low	Insufficient description of randomization; no blinding; no drop-outs
Burr et al. 1980[70]	Unclear	Unclear	Low	Low	Low	Low	Low	Insufficient description of randomization; placebo used; outcomes assessor blinded; 4% attrition

ITT=intention-to-treat

Table C-23. Risk of bias of multicomponent non-RCTs

Study	Representativeness of the Study Population	Ascertainment of Exposure	Comparability of Cohorts on the Basis of the Design or Analysis	Assessment of Outcome	Followup Long Enough for Outcomes to Occur	Adequacy of Followup of Cohorts	Overall Risk of Bias	Comments
Shani et al. 2015[42]	Low	Low	Low	Low	Low	Medium	Low	Non-randomized pre-post study; high attrition rate
Breysse et al. 2014[43]	Low	Low	Low	Low	Low	Low	Low	Non-randomized study with historical, matched control group; propensity scoring used
Turcotte et al. 2014[44]	Low	Low	Low	Low	Low	Low	Low	Non-randomized pre-post study
Sweet et al. 2013[45]	Low	Low	Low	Low	Low	Low	Low	Non-randomized pre-post study

KEY QUESTION 2: What are benefits and harms of using bronchial thermoplasty in the treatment of adult (>18 years) patients with severe asthma in addition to standard treatment?

Table C-24. Study characteristics of comparative trials

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Bicknell et al. 2016[71]	BT in clinic vs. RCT	***Type of study:*** Retrospective, comparative ***Total population:*** N=10 clinic patients N=15 patients from RCTs ***Country:*** U.K. ***Followup:*** 1 year	***Age (mean [SD])*** Clinic: 48 (10) years RCT: 43 (12) years ***% Male:*** Clinic: 70% RCT: 67% ***Race:*** Clinic: %NR RCT: %NR	***Inhaled corticosteroid dose:*** Clinic: BDP equivalent 2580 (SD 1425) mcg/d RCT: BDP equivalent 1757 (SD 1578) mcg/d ***FEV_1 (mean [range]):*** % predicted: Clinic: 72% (±16) RCT: 74% (±12) ***PC_{20} (mg/ml [SD]):*** Clinic: NR RCT: 0.54 (0.84) ***Asthma severity:*** British Thoracic Society Steps 4 and 5 ***Comorbidity:*** NR
Pavord et al. 2013[72] RISA Extension Study 5-year followup of Pavord et al. 2007[2]	BT alone	***Type of study:*** RCT Extension—1 arm ***Total population:*** N=14 BT arm ***Country:*** U.K. ***Followup:*** 4 years (years 2–5)	***Age (mean years [SD])*** 38.6 (13.3) ***% Male:*** 43% ***Race:*** 100% Caucasian	***Inhaled corticosteroid dose (SD):*** BT: BDP equivalent 1166.7 (421) mcg/d ***FEV_1 (mean [SD]): % predicted:*** BT: 63.5% (12.5) ***PC_{20} (mg/ml geometric mean [range]):*** BT: 0.24 (0.1- 1.1) ***Asthma severity:*** All met the Global Initiative for Asthma (GINA) criteria for severe persistent asthma All but one met the American Thoracic Society criteria for refractory asthma ***Comorbidity:*** Seasonal allergies 71%
Wechsler et al. 2013[73] AIR 2 Extension 5-year followup of Castro et al. 2010[1]	BT alone	***Type of study:*** RCT Extension—1 arm ***Total population:*** N=162 BT ***Country:*** U.S. ***Followup:*** 5 years	***Age (mean years [SD])*** BT: 41.5 (11.8) ***% Male:*** 42% ***Race:*** BT: 82.7% Caucasian	***Inhaled corticosteroid dose (SD):*** BT: BDP equivalent 19558.9 (757.9) mcg/d Control: BDP equivalent 1834.8 (2000) mcg/d ***FEV_1 (mean [SD]):*** % predicted: BT: 77.8% (15.84) ***PC_{20} (mg/ml geometric mean [range]):*** BT: 0.27 (0.21- 0.35) ***Asthma severity:*** STEPS 5 or 6 ***Comorbidity:*** NR

Table C-24. Study characteristics of comparative trials (continued)

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Thompson et al. 2011[4] AIR Study extension 5-year followup of Cox et al. 2007[3]	BT vs. medical management	***Type of study:*** RCT Extension—Both arms ***Total population:*** N=45 BT N=24 control ***Country:*** U.K. ***Followup:*** 5 years	***Age (mean years [SD])*** BT: 40.0 (11.2) Control: 40.8 (12.1) ***% Male:*** BT: 42% Control: 38% ***Race:*** BT: 91% Caucasian Control: 92% Caucasian	***Inhaled corticosteroid dose (SD):*** BT: BDP equivalent 1305 (880) mcg/d Control: BDP equivalent 1141 (1053) mcg/d ***FEV_1 (mean [SD]):*** % predicted: BT: 72.5% (10.9) Control: 74.9% (8.9) ***PC_{20} (mg/ml geometric mean [range]):*** BT: 0.25 (0.2- 0.4) Control: 0.35 (0.1-0.6) ***Asthma severity:*** NR ***Comorbidity:*** NR
Castro et al. 2010[1] AIR 2 Study	BT vs. sham	***Type of study:*** RCT ***Total population:*** N=190 BT N=98 control ***Country:*** U.S. ***Followup:*** 1 year	***Age (mean years [SD])*** BT: 40.7 (11.89) Control: 40.6 (11.85) ***% Male:*** BT: 43% Control: 39% ***Race:*** BT: 80% Caucasian Control: 74% Caucasian	***Inhaled corticosteroid dose (median):*** BT: BDP equivalent 1960.7 (2000) mcg/d Control: BDP equivalent 1834.8 (2000) mcg/d ***FEV_1 (mean [SD]):*** % predicted: BT: 77.8% (15.65) Control: 79.7% (15.14) ***PC_{20} (mg/ml geometric mean [range]):*** BT: 0.27 (0.22- 0.34) Control: 0.31 (0.22-0.43) ***Asthma severity:*** NR ***Comorbidity:*** NR
Cox et al. 2007[3] AIR Study	BT vs. medical management	***Type of study:*** RCT ***Total population:*** N=56 BT N=56 control ***Country:*** Canada ***Followup:*** 1 year	***Age (mean years [SD])*** BT: 39.36 (11.18) Control: 41.65 (11.35) ***% Male:*** BT: 44% Control: 43% ***Race:*** BT: 93% Caucasian Control: 93% Caucasian	***Inhaled corticosteroid dose (SD):*** BT: BDP equivalent 1351 (963) mcg/d Control: BDP equivalent 1264 (916) mcg/d ***FEV_1 (mean [SD]):*** % predicted: BT: 72.65% (10.41) Control: 76.12% (9.28) ***PC_{20} (mg/ml [95% CI]):*** BT: 0.25 (0.16–0.40) Control: 0.35 (0.23–0.52) ***Asthma severity:*** Moderate persistent- severe persistent ***Comorbidity:*** Seasonal allergies BT: 62% Control 65%

Table C-24. Study characteristics of comparative trials (continued)

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Pavord et al. 2007[2] RISA Study	BT vs. medical management	***Type of study:*** RCT ***Total population:*** N=15 BT N=17 control ***Country:*** U.K. ***Followup:*** 1 year	***Age (mean years [SD])*** BT: 39.1 (13.0) Control: 42.1 (12.6) ***% Male:*** BT: 40% Control: 59% ***Race:*** BT: 100% Caucasian Control: 100% Caucasian	***Inhaled corticosteroid dose (median):*** BT: BDP equivalent 1166.7 (1000) mcg/d Control: BDP equivalent 1058.9 (1000) mcg/d ***FEV_1 (mean [SD]): % predicted:*** BT: 62.9% (12.2) Control: 66.4% (17.8) ***PC_{20} (mg/ml geometric mean [range]):*** BT: 0.19 (0.05- 0.76) Control: 0.31 (0.08-1.26) ***Asthma severity:*** All met the Global Initiative for Asthma (GINA) criteria for severe persistent asthma All but one met the American Thoracic Society criteria for refractory asthma ***Comorbidity:*** Seasonal allergies BT: 67% Control: 53%

AIR 2 Study=Asthma Intervention Research Trial 2; ATS=American Thoracic Study; BDP: beclometasone equivalent doses; BT=bronchial thermoplasty; FEV_1=forced expiratory volume; NR=not reported; PC_{20}=provocative concentration of methacholine causing a 20% drop in FEV_1; RCT=randomized clinical trial; RISA Study=Research in Severe Asthma Trial Study; SD=standard deviation; U.K.=United Kingdom.; U.S.=United States

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
Bicknell et al. 2016[71]	Clinic: N=10 RCT: N=15	***Composite measures*:** ***ACQ7 from baseline to 12 months (mean difference; MCID -0.5) scores:*** Clinic vs. RCT: -0.5 (-1.5 to 0.4) vs. -0.8 (-1.4 to -0.1) p=0.003 ***Discrete measures*:** FEV_1 % predicted; difference from baseline (range): Clinic vs. RCT: -5 (-11 to 2) vs. 6 (-4 to 15) (p=0.632)	***Exacerbations from baseline to 12 months (mean difference; MCID 1):*** Clinic vs. RCT: -1 (-2 to 1) vs. 0 (-1 to 0) p=0.098 ***Hospital admissions in past 12 months (MCID 1):*** Clinic vs RCT: 0 (-2 to 1) vs. 0 (0 to 0) p=0.192	***Hospitalizations:*** Clinic: 3 (2 for asthma; 1 partial lung collapse) RCT: NR ***ICS use BDP equivalent (mcg [SD]):*** Comparison of in-clinic patients at baseline vs. 12 months after BT: 2,980 (1,000) vs. 1,757 (1,578) p=0.406 RCT patients at baseline vs 12 months: 1,757 (1,578) vs. NR	***AQLQ scores: Change from baseline*** AQLQ (MCID -0.5) Clinic vs. RCT: 0.7 (-0.1 to 1.6) vs. 1.1 (-0.4 to 1.7) p=0.085	NR	Clinic: AEs reported as similar to events reported in clinical trials Clinic: One hospitalization for a partial lung collapse during the periprocedure period (0–6 weeks)

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
Pavord et al. 2013[72] RISA Extension Study 5-year followup of Pavord et al. 2007[2]	BT arm Year 1: n=14 Year 2: n=14 Year 3: n=14 Year 4: n=12 Year 5: n=12	***Composite measures:*** ***ACQ score*** ***Discrete measures:*** Mean prebronchodilator and post-bronchodilator FEV_1 were unchanged 5-year period after BT	***Patients requiring maintenance OCSs*** at 5 years (baseline n=7): Decreased dose: n=4 (2 weaned off OCS) Maintained dose: n=2 Increased dose: n=1 One patient of those not taking maintenance OCS at baseline (n=7) required maintenance OCS at year 5 ***ED visits per patient per year:*** before BT: 0.36 5 years after BT: 0.12 P-value for a repeated-measures logistic regression modeling the percentage of patients reporting an ED visit, was 0.22 for the trend in the proportion of patients with ED visits for respiratory symptoms across years 1 to 5. ***Respiratory-related hospitalizations during followup period:*** 11 events in 5 patients from years 2–5 hospitalizations for asthma exacerbations: 7 events (1 lower respiratory tract infection, 1 wheeze,	***ICS dose (compared with baseline):*** Unchanged: n=4 Increased: n=3 Decreased: n=5 ***Maintenance asthma medication use:*** No significant changes were found in inhaled maintenance asthma medication use overall. LABA dose 5 years after BT compared with baseline: Unchanged: n=2 Increased: n=2 Decreased: n=2	***AQLQ score:*** ***Patient Satisfaction Questionnaire (11/12 respondents at 5-years):*** Definitely undergo BT again: n=10 Would recommend BT to a friend or family member: n=9 “definitely yes”; n=2 “probably yes”	No deaths occurred	***Respiratory AEs:*** ***% of patients experiencing the AE:*** The rate of respiratory AEs in people treated with BT were unchanged in years 2 to 5 Asthma% Years 1–5: 7.1%, 35.7%, 50.0%, 16.7%, 41.7% Bronchitis Years 1–5: 7.1%, 14.3%, 21.4%, 8.3%, 8.3% Bronchospasm Years 1–5: 0%, 7.1%, 0%, 0%, 0% Chest discomfort Years 1–5: 21.4%, 0%, 0%, 8.3% Chest pain Years 1–5: 7.1%, 0%, 5.9%, 14.3%, 8.3%, 8.3% Cough Years 1–5: 42.9%, 0%, 7.1%, 0%, 0% Dyspnea Years 1–5: 64.3%, 0%, 0%, 8.3%, 0% Dyspnea exacerbated Years 1–5: 14.3%, 0%, 0%, 0% 0% Epistaxis Years 1–5: 14.3%, 0%, 0%, 0%, 0% Hemoptysis Years 1–5: 7.1%, 0%, 0%, 0%, 0%, Hoarseness Years 1–5: 7.1%, 0%, 7.1%, 0%, 0% LRTI Years 1–5: 42.9%, 35.7%, 28.6%, 41.7%, 58.3% LRT inflammation Years 1–5: 0%, 0%, 0%, 0%, 8.3% Nasal congestion Years 1–5: 35.7%, 0%, 0%, 0%, 0% Nasopharyngitis Years 1–5: 28.6%, 0%, 7.1%, 8.3%, 8.3% Nocturnal dyspnea Years 1–5: 21.4%, 0%, 0%, 0%, 0% Pharyngolaryngeal pain Years 1–5:

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
			2 semi-elective for prophylactic intravenous infusion of aminophylline) 1 patient accounted for 6 hospitalizations ***Respiratory-related hospitalizations per patient per year:*** 12 months before study: 0.71 Year 1: 0.36 Year 2: 0.43 Year 3: 0.21 Year 4: 0.08 Year 5: 0.08 Overall 5 years after BT: 0.23 per patient per year (68% reduction from 12 months prior to BT)				14.3%, 0%, 0%, 8.3% 0% Productive cough Years 1–5: 64.3%, 0%, 7.1%, 0%, 0% Rhinitis Years 1–5: 7.1%, 0%, 14.3%, 0%, 0% Sinusitis Years 1–5: 0%, 0%, 7.1%, 8.3%, 0% Sputum discolored Years 1–5: 21.4%, 0%, 0%, 0%, 0% Throat irritation Years 1–5: 0%, 0%, 0%, 0%, 8.3% URTI Years 1-5: 35.7%, 0% 14.3%, 16.7%, 16.7% Wheezing Years 1–5: 71.4%, 7.1%, 14.3%, 0%, 8.3%

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
Wechsler et al. 2013[73] AIR 2 Extension 5-year followup of Castro et al. 2010[1]	BT treated patients n=162 of 190 BT-treated patients form AIR 2 study 85.3% completed 5-year followup Year 1: n=181 Year 2: n=165 Year 3: n=162 Year 4: n=159 Year 5: n=162	***Discrete measures:*** % predicted pre-bronchodilator FEV_1 values remained unchanged over the 5 years	***ER Visit for serious respiratory symptoms:*** Average reduction 12 months before BT vs. over the 5 years after BT: 78% ***ER visits:*** Average reduction 12 months before BT vs over 5 years after BT: 88% ***Hospitalizations for Respiratory symptoms (Events/patient/ year [95% CI]):*** 12 months before BT: 0.053 [0.04, 0.08] Year 1: 0.04 [0.025, 0.060] Year 2: 0.061 [0.042, 0.087] Year 3: 0.068 [0.048, 0.096] Year 4: 0.076 [0.054, 0.105] Year 5: 0.025 [0.014, 0.044] Average over 5 years: 0.053 [0.038, 0.073] The proportion of respiratory hospitalizations for respiratory symptoms did not increase over 5 years ***Severe***	***Maintenance Medication Changes*** <u>Baseline</u>: 72% of patients were prescribed 2 maintenance medications (i.e., high dose ICS >1000 µg BDP equivalent and LABA), and 28% of people were prescribed 3 or more maintenance medications. <u>At 5 years following BT</u>: 27% of patients decreased ICS by 50% or more; half of patients reduced daily ICS to ≥500 mcg/day BDP equivalent 5% of patients increased ICS by 50% or greater Patients who changed ICS dose by 50% or greater were more likely to decrease ICS compared to increase ICS ($p<0.001$) Overall reduction of 17% in the average ICS dose at 5 years 12% were completely weaned off LABA, 9% were weaned off ICS and LABA maintenance medications, and 7% were no longer taking any maintenance	NR	No deaths due to BT	***Respiratory adverse events occurring in ≥3.0% of patients in years 1 through 5:*** Asthma (multiple symptoms) Bronchitis Cough Influenza Lower respiratory tract infections Nasopharyngitis Pneumonia Rhinitis Sinusitis Upper respiratory tract infections Wheezing ***Respiratory AEs (Events/patient/year [95% CI])*** 12 months before BT: NA Year 1: 2.02 [1.764, 2.318] Year 2: 1.22 [1.013, 1.465] Year 3: 1.25 [1.037, 1.499] Year 4: 1.18 [0.971, 1.424] Year 5: 0.78 [0.616, 0.982] Average over 5 years: 1.30 [1.149, 1.481] The proportion of respiratory AEs did not increase over 5 years ***Asthma AEs (Events/patient/year [95% CI])*** 12 months before BT: NA Year 1: 0.481 [0.379, 0.609] Year 2: 0.461 [0.357, 0.594] Year 3: 0.506 [0.396, 0.646] Year 4: 0.503 [0.393, 0.644] Year 5: 0.321 [0.236, 0.436] Average over 5 years: 0.45 [0.374, 0.554] The proportion of asthma (multiple symptoms) did not increase over 5 years

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
			exacerbations: Frequency in years 2–5 compared with year 1 were n.s. Patients reporting severe exacerbations in the year After BT: 30.9% 12 months before BT: 51.6% Reductions maintained for 5 years with an average decrease of 44% ***Severe exacerbations (matched pairs analysis n=162 at years 1, 2, 3, 4, and 5):*** 30.9%, 23.5%, 34.0%, 36.4%, and 21.6% 53.1% experienced 1 or more exacerbations 12 months before BT Average reduction over 5 years compared to the 12 months prior to BT: 48% (upper 95% Confidence limit for Years 2, 3, 4, and 5 compared to Year 1 was 0.5, 11.3, 14.0, and -1.6, respec-tively; all less than the predefined non-inferiority margin of 20%)	asthma medications			
Thompson 2011[4]	Patients with 1 year	***Composite measures:***	***Oral Corticosteroid use BT vs. Control***	***LABA use (BT over 5 years, Control over***	NR	None	**Treatment period plus 6 weeks' *Respiratory adverse events (events***

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
AIR Study extension 5-year followup of Cox 2007[3]	followup (vs. extension) BT n=52 (45) Control n=49 (24) Year 2 BT: n=45 Control: n=24 Year 3: BT: n=43 Control: n=21 Year 4: BT n=43 Year 5: BT: n=42 68.3% enrolled in followup	NR ***Discrete measures: Pulmonary Function Tests:*** FEV_1 and FVC did not deteriorate over 5 years post-BT. ***PC20 doublings BT vs. Control (SD):*** Year 1: 1.53 (2.29) vs 1.00 (2.46) p=0.378 Year 2: 1.21 (2.99) vs -0.47 (2.31) p=0.024 Year 3: 1.31 (2.96) vs -0.44 (2.27) p=0.025	***(high-dose pulses/patient/year [% of patients]):*** Year 1: 0.60 (24.5%) vs. 0.42 (20.8%) Year 2: 0.49 (24.5%) vs. 0.54 (33.3%) Year 3: 0.33 (25.6%) vs. 0.52 (23.8%) Year 4: 0.63 (27.9%) Year 5: 0.62 (30.9%) ***Hospitalizations*** ***BT vs Control:*** Year 1: 6.7% vs. 0% (p=0.55) Year 2: 6.7% vs. 0% (p=0.55) Year 3: 2.3% vs. 4.8% (p=1.00) Hospitalizations for respiratory symptoms in the BT arm did not increase over 5-year followup compared with year 1 after BT (p=0.16; repeated measures analysis for proportion of subjects). ***Emergency room visits:*** ***BT vs Control:*** Year 1: 6.7% vs. 0% (p=0.55) Year 2: 6.7% vs. 0% (p=0.55) Year 3: 2.3% vs. 4.8% (p=1.00)	***3 years compared with baseline)*** BT vs control: Decrease: 57% vs. 54% No change:40% vs. 43% Increase: 3% vs. 3% Discontinued use: 49% vs 47% ***ICS (mean) reduction from Baseline:*** BT Years 1, 2, 3, 4, 5: 182 µg/day (p=0.09), 135 µg/day (p=0.32), 150 µg/day (p=0.25), 151 µg/day (p=0.23), and 194 µg/day (p=0.16) (p-values from a Signed Rank test). Control (Year 3): 112 µg/day, n.s.; comparison between BT and Control at years 2 and 3 (p=0.93 and p=0.92, respectively) BT vs Control at 3 years: Decrease: 27% vs. 29% No change: 56% vs. 52% Increase: 17% vs. 19%			***per patient)*** Year 1: BT: 4.5; Control: 3.1 Year 2: BT: 1.2; Control: 1.2 Year 3: BT: 1.3; Control: 1.3 Year 4: BT: 1.2; Year 5: BT: 1.1 ***Adverse events (% of patients experiencing AE)*** Dyspnea BT Years 1–5: 42.2%, 8.9%, 9.3%, 9.3%, 9.5% Control Years 1–3 50.0%, 12.5%, 14.3% Cough BT Years 1–5: 37.8%, 8.9%, 4.7%, 7.0%, 4.8% Control years 1–3 29.2%, 4.2%, 14.3% Wheeze BT years 1–5: 31.1%, 4.4%, 7.0%, 7.0%, 4.8% Control years 1–3: 16.7%, 4.2%, 4.8% Nasal congestion BT years 1–5: 28.9%, 4.4%, 0%, 0%, 2.4% Control years 1–3: 20.8%, 0%, 0% Upper respiratory tract infection BT years 1–5: 22.2%, 24.4%, 18.6%, 18.6%, 9.5% Control years 1–3: 8.3%, 16.7%, 19.1% Productive cough BT year 1–5: 20.0%, 4.4%, 4.7%, 0% Control years 1–3: 20.8%, 4.2%, 0%, 2.4% Chest discomfort BT years 1–5:

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
							17.8%, 4.4%, 7.0%, 7.0% 4.8% Control years 1–3: 12.5%, 8.3%, 4.8% <u>Nasopharyngitis</u> BT years 1–5: 13.3%, 2.2%, 0%, 2.3%, 2.4% Control years 1–3: 0%, 0%, 0% <u>Nocturnal dyspnea</u> BT years 1–5: 13.3%, 0%, 0%, 0%, 0% Control years 1–3: 8.3%, 0%, 0% <u>Respiratory tract infection</u> BT years 1–5: 11.1%, 6.7%, 11.6%, 11.6%, 9.5% Control years 1–3: 20.8%, 8.3%, 4.8% <u>Pharyngolaryngeal pain</u> BT years 1–5: 11.1%, 0%, 0%, 0%, 0% Control years 1–3: 12.5%, 0%, 0%, 0% <u>Respiratory Tract congestion</u> BT years 1–5: 8.9%, 0%, 0%, 0%, 0% Control years 1–3: 8.3%, 0%, 0% <u>Discolored sputum</u> BT years 1–5: 8.9%, 0%, 0%, 0%, 0% Control years 1–3: 6.7%, 0%, 0%, 0% <u>Rhinitis</u> BT years 1–5: 4.4%, 0%, 2.3%, 0% 4.8% Control years 1–3: 0%, 0%, 0% <u>Bronchitis</u> BT years 1–5: 2.2%, 2.2%, 2.3%, 2.3%, 2.4% Control years 1–3: 0%, 4.2%, 9.5% <u>Pharyngitis</u> BT: years 1–5:

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
							2.2%, 0%, 0%, 0%, 0% Control years 1–3: 4.2%, 0%, 0% Pleuritic Pain BT years 1–5: 2.2%, 0%, 0%, 0%, 0% Control years 1–3: 4.2%, 0%, 0% Rhinorrhea BT years 1–5: 2.2%, 0%, 2.3%, 0%, 0% Control years 1–3: 4.2%, 0%, 0% Asthma (multiple symptoms) BT: years 1–5: 0%, 8.9%, 16.3%, 16.3%, 14.3% Control years 1–3: 0%, 8.3%, 4.8%, Sinusitis BT years 1–5: 0%, 2.2%, 4.7%, 4.7%, 4.8% Control years 1–3: 0%, 4.2%, 0% Nasal polyps BT years 1–5: 0%, 2.2%, 0%, 4.7%, 0% Control years 1–3: 0%, 0%, 0% Pneumonia BT years 1–5: 0%, 0%, 2.3%, 0%, 0% Control years 1–3: 0% 0%, 4.8%

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
Castro 2010[1] AIR 2 Study	BT: N=190 Sham: N=98 Completed 12 month followup BT: N=181 Sham: N=97 96.5% completed study	***Composite measures*:** *ACQ scores at 12-month followup:* BT: 1.31 (0.94) Sham: 1.32 (0.91) ***Discrete measures*:** FEV_1 Pre-bronchodilator, % predicted baseline to 12 months: BT: Baseline: 77.8 (15.65) 12 months: 76.6 (17.74) Sham: Baseline: 79.7 (15.14) 12 months: 79.1 (15.98) (PPS 24.1%) ***Morning PEF (L/min):*** Baseline BT: 383.8 (104.32) Sham: 386.3 (112.59) 12-month BT:411.6 (110.45) Sham: 408.7 (117.56) PPS 80.6% ***Total symptom score:*** Baseline BT: 3.8 (2.34) Sham: 3.9 (2.53) 12 months BT: 2.1 (2.22) Sham: 2.3 (2.17) PPS: 63.7%	***Severe exacerbation rate over 12 months severe exacerbations per patient/year):*** BT: 0.48 (0.067) Sham: 0.70 (0.122) PPS 95.5% ***Hospitalizations for respiratory symptoms:*** BT: 5 people (2.6%) had a total of 6 hospitalizations Sham: 4 people (4.1%) had 12 hospitalizations (one person had 9 hospitalizations) ***Number of severe exacerbations over the entire study period per patient:*** BT: 1.02 (53.6% of patients) Sham: 0.91 (45.9% of patients) (PPS sham >BT=25.8%) ***ED visits for respiratory symptoms per patient over 12 months:*** BT: 0.13 (8.4% of subjects) Sham: 0.45 (15.3% of subjects) (PPS >BT=99.7%); ***Number of respiratory-related hospitalizations per subject:*** BT: 0.13 (10.5% of	***Rescue medication use (puffs/7 days)*** Baseline BT: 13.4 (19.17) Sham: 11.8 (11.24) 12 months BT: 7.4 (15.01) Sham: 7.5 (12.60) PPS, 81.3 ***% Days rescue medication used*** Baseline BT: 52.1 (36.48) Sham: 51.8 (35.41) 12 months BT: 28.0 (36.09) Sham: 29.8 (34.96) PPS 68.0%	***AQLQ change from baseline at 12 month followup (SD)*** BT: 1.35 (1.10) Sham: 1.16 (1.23) PPS, 96.0% ***Clinically meaningful improvement*** *in AQLQ score 0.5 or greater:* BT: 79% Sham: 64% (PPS, 99.6%) ***Percent symptom-free days' baseline*** BT: 16.4 (24.04) Sham: 16.8 (23.10) 12 months BT:40.8 (38.22) Sham: 37.9 (36.95) p=0.776 ***Days lost from work/school/other activities due to asthma at 12 months*** BT: 1.315 (0.361) Sham: 3.915 (1.553) PPS=99.3%	None	***Adverse events*** BT: 85% (1.0 events/bronchoscopy) Sham: 76% of patients (0.7 events/bronchoscopy) ***Severity of respiratory AEs for BT vs. sham*** Mild: 43.6% vs. 58.7% Moderate: 53.2% vs. 39.8% Severe: 3.1% vs. 1.5% ***Most common airway irritation events after procedure:*** Worsening asthma symptoms (wheezing, chest discomfort, cough, and chest pain) and upper respiratory tract infections <u>During the treatment period</u> BT: 16 people (8.4%) required 19 hospitalizations (10 occurred on the day of the procedure) for respiratory symptoms (worsening of asthma, 12 in 10 subjects; segmental atelectasis, 3 in 2 subjects; lower respiratory tract infection, 1 subject; low FEV_1, 1 subject; hemoptysis, 1 subject; and aspirated prosthetic tooth; one subject) Sham: Two patients (2.0%) required two hospitalizations (both worsening of asthma) <u>During the post treatment period</u> Respiratory AEs reported in people treated with BT vs. sham 70% of vs. 80% ***Proportion of people reporting worsening of asthma BT vs. sham:*** 27.3 vs. 42.9% (PPS=99.7%) ***Rate of upper and lower respiratory tract infections requiring antibiotics (SD):*** BT: 0.007 (0.014) events/subject/week (24.1% of patients) Sham: 0.006 (0.012) events/subject/week (24.5% of patients)

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
			subjects) Sham: 0.14 (5.1% of subjects) (PPS sham >BT=57.2%) ***Risk reduction in ED visits for respiratory symptoms BT vs. sham:*** 84% 0.07 vs. 0.43 visits/subject/yr; 84% reduction; PPS=99.9%				
Cox 2007[3] AIR Study	BT N=56 (52) Control: N=56 (49) 90.2%	***Composite measures*:** ***ACQ score:*** Baseline BT: 2.50 (0.92) Control: 2.16 (0.86) At 12 months BT: 1.32 (0.85) Control: 1.69 (0.99) (p=0.001) ***Discrete measures*:** ***Increase in morning PEF from baseline to 12 months (SD):*** BT: 349.3 (90.6) to 388.6 (105.0) L/min, Control: 372.4 (99.9) to 380.9 (92.9) L/min (p=0.003) ***Increase in evening PEF from baseline to 12 months (SD):*** BT: 359.7 (88.4) L/min to 397.4 (102.8) Control: 379.1 (98.7) to 389.0 (93.9) (p=0.006) ***Prebronchodilator FEV1 % predicted***	***Severe exacerbations per patients per week in past 12 months (Mean) BT vs Control:*** Baseline BT: 0.07±0.18 Control: 0.09±0.31 12 months BT: 0.01±0.08 Control: 0.06±0.24 Difference between the two groups in the change from baseline at 12 months=n.s. ***Exacerbations during the 2-week periods at 3, 6, and 12 months when patients were treated with ICS alone compared with baseline:*** BT: -0.16±0.37 vs. Control: 0.04±0.29 (p=0.005 for comparison between groups) Analysis with Wilcoxon rank-sum method (p=0.01 between the	***Rescue medication use (puffs per week)*** Baseline BT: 19.8 (17.2) Control: 16.0 (18.8) 12 months BT: 10.9 (15.0) Control: 14.8 (21.2)	***AQLQ score (SD)*** Baseline BT: 4.91 (1.23) to Control: 5.15 (1.19) 12 months BT: 18 (0.88) Control: 5.72 (1.11) (p=0.003) ***High Dose ICS (post-hoc analysis n=32; 16 BT, 16 Control) who required >1000 µg BDP or equivalent at baseline*** ***AQLQ*** *BT:* 4.45 (1.48) to 6.17 (0.89) Control: 5.41 (0.81) to 5.67 (1.13) (p=0.002)	None	***Treatment period plus 6 wk*** ***AE frequency BT vs. Control (% patients with AE)*** Dyspnea 70.9% vs. 33.3% (p<0.001) Wheezing 61.8% vs. 13.0% (p<0.001) Cough 52.7% vs. 18.5% (p<0.001) Chest discomfort 47.3% vs. 20.4% (p=0.004) Night awakenings 40.0% vs. 9.3% (p<0.001) Productive cough 40.0% vs. 11.1% (p<0.001) Upper respiratory tract infection 12.7% vs. 3.7% (p=0.16) Bronchial irritation 9.1% vs. 0% (p=0.06) Nasal congestion 12.7% vs 11.1% (p=1.00) Sputum discolored 10.9% vs 0% (p=0.03) Dry mouth 3.6% vs. 0% (p=0.50) Abnormal chest sound 5.5% vs. 0% (p=0.24) Bronchospasm 7.3% vs. 0% (p=0.12) ***Post-treatment period (6 weeks–12 months)*** Dyspnea 49.1% vs. 53.8% (p=0.70) Cough 38.2% vs. 36.5% (p=1.00) Nasal congestion 27.3% vs. 26.9% (p=1.00) Wheezing 29.1% vs. 23.1% (p=0.52) Productive cough 23.6% vs. 23.1% (p=1.00)

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
		Baseline vs. 12 months (SD): BT: 70.4 (12.1) vs. 75.2 (13.9) Control: 70.7 (10.5) vs. 72.4 (12.6) NS ***PC_{20} the geometric mean (95% CI) from baseline to 12 months (SD):*** BT: 0.24 (0.15, 0.4) to 0.61 (0.36, 1.03) mg/ml, or 1.31 (2.39) doubling concentrations over baseline Control: 0.32(0.20, 0.51) to 0.5(0.31, 0.80) mg/ml, or 0.66 (2.69) doublings (p=0.17) ***Asthma Symptoms and Symptom-Free Days from baseline to 12 months:*** <u>Symptoms free days</u> BT: 24.7 (30.5) to 65.4 (40.4) Control group SFD 32.3 (34.3) to 49.4 (41.3) (p=0.005) Investigators extrapolated BT group might gain 148 symptom-free days per year compared with 62 with Control (n.s. at 12 months) <u>Total symptom score from baseline to 12</u>	groups) ***Mild exacerbations per patients per week in past 12 months (Mean) BT vs. Control:*** Baseline BT: 0.35±0.32 Control: 0.28±0.31 12 months BT: 0.18±0.31 Control: 0.31±0.46 Difference between the two groups in the change from baseline at 12 months (p=0.03 for both comparisons)				Chest discomfort 21.8% vs. 13.5% (p=0.32) Upper respiratory tract infection 18.2% vs 5.8% (p=0.07) Night awakenings 12.7% vs. 9.6% (p=0.76) Pharyngolaryngeal pain 10.9% vs.13.5% (p=0.77) Nasopharyngitis 10.9% vs. 5.8% (p=0.49) Respiratory tract congestion 9.1% 3.8% (p=0.44) Respiratory tract infection 9.1% vs. 17.3% (p=0.26) Bronchitis 1.8% 0% (p=1.00) Throat irritation 3.6% vs. 3.8% p=1.00

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
		months BT: 3.16 (2.21) to 1.25 (1.97) Control: 2.65 (2.55) to 2.00 (2.23) (p=0.01) ***Patients taking high dose ICS (post-hoc analysis n=32; 16 BT, 16 Control) who required >1000 µg BDP or equivalent at baseline:*** Composite measures ACQ BT: 2.88 (0.63) to 1.34 (0.95) Control: 2.20 (0.67) to 1.99 (1.02) (p=0.004) Discrete measures Morning PEF increase form baseline to 12 months BT: 378.2 (69.8) to 441.8 (103.9) L/min Control: 321.9 (65.9) to 346.2 (66.4) L/min (p=0.05) Airway hyper-responsiveness PC_{20} [geometric mean (95% CI) from baseline to 12 months BT: 0.33 (0.11, 0.97) to 1.71 (0.65, 4.49) mg/ml, or 2.39 (SD 2.78) doublings					

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
		from baseline Control: 0.45(0.19, 1.03) to 0.30(0.09, 1.01) mg/ml, or -0.57 (SD 3.04) doublings from baseline; (p=0.03)					
Pavord 2007[2] RISA Study	N=34 BT: N=17 Control Medical management (N=17) Completed study BT: N=15 Control: N=17	***Composite measures:*** ***ACQ score:*** BT vs. Control: -0.99 (0.83) vs. -0.22 (0.78), (p=0.01)	***Number of patients able to wean off OCS*** (through week 52): BT: 4 of 8 patients Control: 1 of 7 patients (p=0.28) ***Mean reduction in OCS dose:*** BT: 63.5 (45.4) % Control: 26.2 (40.7) % (p=0.12) ***Treatment period Hospitalizations for respiratory adverse events:*** BT: 7 in 4 patients Events were due to asthma exacerbations and two events included partial collapse of a lower lobe of the lung 1 and 2 days after BT, respectively Control: No hospitalizations <u>Median length of stay for the hospitalizations</u>: 2 days ***Post-treatment period:*** Hospitalizations	***Overall reduction in ICS dose*** BT: 28.6 (30.4) % Control: 20.0 (32.9) % (p=0.59) ***Reduction in short-acting b2-agonist use at 52 weeks BT vs. Control:*** -25.6 (31.2) vs. -6.1 (12.4) puffs/week, (p<0.05) ***Rescue medication use at 22 weeks (puffs/week)*** BT: -26.6 (40.1) Control: -1.5 (11.7) p=0.05	***AQLQ score (change from baseline to 12 months)*** BT 1.53 (0.79) Control 0.42 (0.82) p=0.001	None	***Respiratory AEs*** <u>Treatment Period</u> Wheezing BT vs. Control: 17.6% vs. 7.0% p=0.072 Cough BT vs. Control: 16.9% vs. 17.5% p=1.000 Chest discomfort BT vs. Control: 15.4% vs. 5.3% p=0.057 Dyspnea BT vs. Control: 15.4% vs. 15.8% p=1.000 Productive cough BT vs. Control: 11.8% vs. 17.5% p=0.355 Sputum discolored BT vs. Control: 5.1% vs. 0.0% p=0.107 Nasal congestion BT vs. Control: 2.9% vs. 5.3% p=0.423 Nasopharyngitis BT vs. Control: 2.2% vs. 7.0% p=0.198 Pharyngolaryngeal pain BT vs. Control: 2.2% vs. 1.8% p=1.000 Atelectasis BT vs. Control: 1.5% vs. 0.0% p=1.000 Bronchial irritation BT vs. Control: 1.5% vs. 0.0% p=1.000 Lower respiratory tract infection BT vs. Control: 1.5% vs. 8.8% p=0.025 Upper respiratory tract infection BT vs. Control: 1.5% vs. 5.3% p=0.154 <u>Post-treatment period</u> Wheezing BT vs. Control: 15.6% vs. 15.4% p=1.000 Cough

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
			BT: 5 occurred in 3 patients Control: 4 in one patient n.s. (p=0.32) ***Exacerbations:*** Control: 1 patient on Day 42 ICU (respiratory failure)				BT vs. Control: 10.7% vs. 8.9% p=0.674 Chest discomfort BT vs. Control: 3.3% vs. 12.2% p=0.015 Dyspnea BT vs. Control: 20.5% vs. 25.2% p=0.447 Productive cough BT vs. Control: 13.9% vs. 11.4% p=0.570 Sputum discolored BT vs. Control: 0% vs. 0% p=1.000 Nasal congestion BT vs. Control: 4.1% vs. 4.9% p=1.000 Nasopharyngitis BT vs. Control: 5.7% vs. 4.9% p=0.784 Pharyngolaryngeal pain BT vs. Control: 1.6% vs. 0.8% p=0.622 Atelectasis BT vs. Control: 0% vs. 0% p=1.000 Bronchial irritation BT vs. Control: 0% vs. 0% p=1.000 Lower respiratory tract infection BT vs. Control: 7.4% vs. 4.9% p=0.439 Upper respiratory tract infection BT vs. Control: 8.2% vs. 6.5% p=0.634 ***Respiratory AEs during treatment period:*** BT: 136 AEs; Mild: 49%; Moderate: 41%; Severe: 10% Control: 57 AEs; Mild: 49%; Moderate: 47%; Severe: 4% ***Treatment period severe respiratory AEs*** BT: 2 people had 5 events (chest infection, increased wheeze, cough, and shortness of breath on exertion) Control: 2 patients (dyspnea, chest infection) that did not require hospitalization ***Post-treatment period severe respiratory AEs*** BT: 2 patients had 5 severe respiratory

Table C-25. Outcomes of comparative bronchial thermoplasty studies and associated followup studies (continued)

Reference	Attrition %	Asthma Control	Exacerbations	Healthcare Utilization and Costs	Quality of Life	Mortality	Adverse Events
							AEs (increased wheeze, chest tightness, increased breathlessness, nocturnal wheeze, and chest infection) Control: 1 patient had one severe respiratory AE (flu-like syndrome)

ACQ=Asthma Control Questionnaire; ACQ7=Asthma Control Questionnaire 7; AE=adverse event; AQLQ=Asthma Quality of Life Questionnaire; scores range from 1 to 7; BDP=beclomethasone equivalent doses; BT=bronchial thermoplasty; CT=computed tomography; ER=emergency room; FEV_1=forced expiratory volume; ICS=inhaled corticosteroid; ICU=intensive care unit; LABA=long acting beta-agonist; MCID=minimal clinical important difference; NR=not reported; OCS=oral corticosteroid; PC_{20}=provocative concentration of methacholine causing a 20% drop in FEV_1; PEF=peak expiratory flow; PPS=posterior probability of superiority; RCT=randomized clinical trial; SD=standard deviation

Table C-26. Risk of bias assessment for included RCTs

Study	Sequence Generation	Allocation Concealment	Blinding of Participants, Personnel and Outcome Assessors	Incomplete Outcome Data	Selective Outcome Reporting	Other Sources of Bias	Comments
Castro et al. 2010[1] AIR 2 Study	Low	Unclear	Low	Low	Low	High	Study was randomized, double-blind, sham-controlled trial; Patients and outcome assessors blind, ITT used; Allocation method described but concealment not explicit; study funded by BT device manufacturer
Cox et al. 2007[3] AIR Study	Low	Low	High	Low	Low	High	Unblinded study, ITT used; study funded by BT device manufacturer
Pavord et al. 2007[2] RISA Study	Low	Low	High	Low	Low	High	Unblinded study, full followup of all patients who began trial, lack of clarity regarding role of funding agency; study funded by BT device manufacturer

AIR 2 Study=Asthma Intervention Research Trial 2; ITT=intention-to-treat; RISA Study=Research in Severe Asthma Trial Study

Table C-27. Study characteristics of descriptive studies

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
McCambridge et al. 2016[74]	BT	***Type of study:*** *Case Study* ***Total population:*** N=1 ***Country:*** U.S. ***Followup:*** 6 months	***Age (mean):*** 77 years Female ***Race:*** NR	***Inhaled corticosteroid dose:*** NR ***FEV_1 (mean [SD]):*** NR ***PC_{20}:*** NR ***Asthma severity:*** Severe, Step NR ***Comorbidity:*** NR
Nguyen et al. 2016[75]	BT	***Type of study:*** *Case Study* ***Total population:*** N=1 ***Country:*** U.S. ***Followup****:* 3 days for complications	***Age (mean):*** 66 years Female ***Race:*** NR	***Inhaled corticosteroid dose:*** NR ***FEV_1 (mean [SD]):*** NR ***PC_{20}:*** NR ***Asthma severity:*** Severe, Step NR ***Comorbidity:*** Hypertension
Balu et al. 2015[76]	BT	***Type of study:*** *Case Study* ***Total population:*** N=1 ***Country:*** U.K. ***Followup:*** 9 weeks	***Age (mean):*** 43 years Female ***Race:*** Caucasian	***Inhaled corticosteroid dose:*** NR ***FEV_1 (mean [SD]):*** Prebronchodilator ***FEV_1:*** NR ***PC_{20}:*** NR ***Asthma severity:*** Severe; Step 5 ***Comorbidity:*** Bipolar disorder
Facciolongo et al. 2015[77]	BT	***Type of study:*** *Case Study* ***Total population:*** N=1 ***Country:*** Italy ***Followup:*** 12 months	***Age (mean):*** 49 years Male ***Race:*** Caucasian	***Inhaled corticosteroid dose:*** BDP equivalent ***Dosage:*** *8*00 mcg/d ***FEV_1 (mean [SD]):*** Prebronchodilator ***FEV_1***: 66% predicted ***PC_{20}:*** NR ***Asthma severity:*** Severe, Step NR ***Comorbidity:*** common variable immunodeficiency
Doeing et al. 2013[78]	BT	***Type of study:*** *Case Study* ***Total population:*** N=1 ***Country:*** U.S. ***Followup:*** 6 months	***Means Age:*** 62 years Female ***Race:*** Caucasian	***Inhaled corticosteroid dose:*** BDP equivalent ***Dosage:*** 500 mcg/d ***Prebronchodilator FEV_1 % predicted:*** 26% ***Asthma severity:*** STEP 6 ***Comorbidity:*** gastroesophageal reflux disease and obstructive sleep apnea
Doeing et al. 2013[79]	BT	***Type of study:*** *Retrospective*, observational ***Total population:*** N=8 ***Country:*** U.S. ***Followup:*** Up to 72 weeks	***Means Age (SEM):*** 47 (4.3) years ***% Male:*** 50% ***Race:*** 63% Caucasian	***Inhaled corticosteroid dose:*** BDP equivalent ***Dosage:*** 1000 mcg/d ***Prebronchodilator FEV_1 % predicted:*** 30.0% (2.3) ***Asthma severity:*** STEP 5 or 6 ***Comorbidity:*** NR
Mahajan et al. 2012[80]	BT	***Type of study:*** *C*ase study ***Total population:*** N=1 ***Country:*** U.S. ***Followup:*** 1 year	***Age:*** 42 years ***Sex:*** Female ***Race:*** South Asian	***Inhaled corticosteroid dose:*** 500 mg fluticasone twice daily ***FEV_1:*** 0.95 L ***Asthma severity:*** Severe; Step NR ***Comorbidity:*** history of eczema and recurrent sinus infections; unable to tolerate oral corticosteroids due to the dysphoria and suicidal ideations

Table C-27. Study characteristics of descriptive studies (continued)

Study	Intervention	Study Design	Demographic Factors	Clinical Factors
Cox et al. 2006[81]	BT	***Type of study:*** *Prospective*, observational ***Total population:*** N=16 ***Country:*** Canada ***Followup:*** 2 year	***Age (mean):*** 39 years ***Age (range)*:** 24-58 ***% Male:*** 38% ***Race:*** 94% Caucasian	***Inhaled corticosteroid dose:*** BDP equivalent ***Dosage (% of patients)*** None: 1 (6.3%) Low dose <250 mcg/d: 1 (6.3%) Medium dose 250–500 mcg/d: 13 (81.3%) High dose >500 mcg/d: 1 (6.3%) ***FEV_1 (mean [SD]):*** Prebronchodilator ***FEV_1*** % predicted: 82.28% (13.97) ***PC_{20} (95% CI):*** 0.92 (0.42–1.99) ***Asthma severity:*** Severe; Step NR ***Comorbidity:*** NR

BDP=beclomethasone equivalent doses; BT=bronchial thermoplasty; CI=confidence interval; FEV_1=forced expiratory volume; NR=not reported; PC20=provocative concentration of methacholine causing a 20% drop in FEV1; RCT=randomized clinical trial; SD=standard deviation; SEM=standard error of the mean; U.K.=United Kingdom; U.S.=United States

Table C-28. Outcomes of descriptive bronchial thermoplasty studies

Reference	Adverse Events
McCambridge et al. 2016[74]	7 days after BT, bilateral bronchial wall thickening, which resolved by 40 days after BT
Nguyen et al. 2016[75]	***Adverse events*** Distress, wheezing, tachycardia, inspiratory lung crackles, diminished breath sounds, reddened airways, dynamic airway collapse and mucous plugging ***Serious adverse events*** Pulmonary embolism with pleural effusion and posterior mediastinal involvement Bilateral lower extremity deep venous thrombi, shock, Pleural effusion with acute anemia due to mediastinal hematoma Hemothorax with bleeding and bronchial artery pseudoaneurysm
Balu et al. 2015[76]	Left-sided chest pain radiating round to the back (worse on inspiration with increased shortness of breath, wheeze and a dry cough), fever, tachypnea wheeze, lung collapse, lung abscess with associated asthma exacerbations
Facciolongo et al. 2015[77]	First BT session: Acute respiratory failure, reduced breath sounds, severe bronchospasm with tachypnea, lung collapse, lung occlusion by bronchus-shaped plugs Second BT session: Severe bronchospasm with respiratory failure, partial lung collapse, mucus plug occluding bronchus
Doeing 2013[78]	First BT procedure: Hospitalized overnight due to requiring frequent nebulized albuterol treatments Second BT procedure: Asthma exacerbation Final BT procedure: Hospitalized overnight due to requiring frequent nebulized albuterol treatments

Table C-28. Outcomes of descriptive bronchial thermoplasty studies (continued)

Reference	Adverse Events
Doeing 2013[79]	After initial BT procedure: Patients (n=4) required overnight observation due to wheezing and/or increased frequency of rescue bronchodilator use After second BT procedure: Patients (n=2) required overnight observation: one had partial lung collapse; one required increased bronchodilator use After third BT procedure: Patients (n=3) required overnight observation: two required admissions for frequent bronchodilator use and one had a lower respiratory tract infection One patient developed mild hemoptysis and lower respiratory tract infection
Mahajan 2012[80]	First BT: Dyspnea refractory to nebulized albuterol requiring hospitalization Second BT: Partial lung collapse secondary to mucus plugging requiring hospitalization Third BT: Dyspnea with wheezing requiring hospitalization
Cox 2006[81]	***Device- related Adverse events (%):*** Cough: 21% Dyspnea: 12% Wheezing: 11% Bronchospasm: 10% Fever: 9% Chest discomfort: 8% Mucus production: 7% Throat irritation: 5% Headache: 3% Congestion: 3% Hemoptysis: 3% Localized heat: 2% Retained mucus: 2% Bronchitis: 1% Hypoxemia: 1% Hoarseness: 1%H Lower back pain: 1%

ACQ=Asthma Control Questionnaire; ACQ7=Asthma Control Questionnaire 7; AQLQ=Asthma Quality of Life Questionnaire; scores range from 1 to 7; BDP=beclomethasone equivalent doses; BT=bronchial thermoplasty; CT=computed tomography; ER=emergency room; FEV_1=forced expiratory volume; MCID=minimal clinical important difference; NR=not reported; PC_{20}=provocative concentration of methacholine causing a 20% drop in FEV_1; PEF=peak expiratory flow; RCT=randomized clinical trial; SD=standard deviation

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